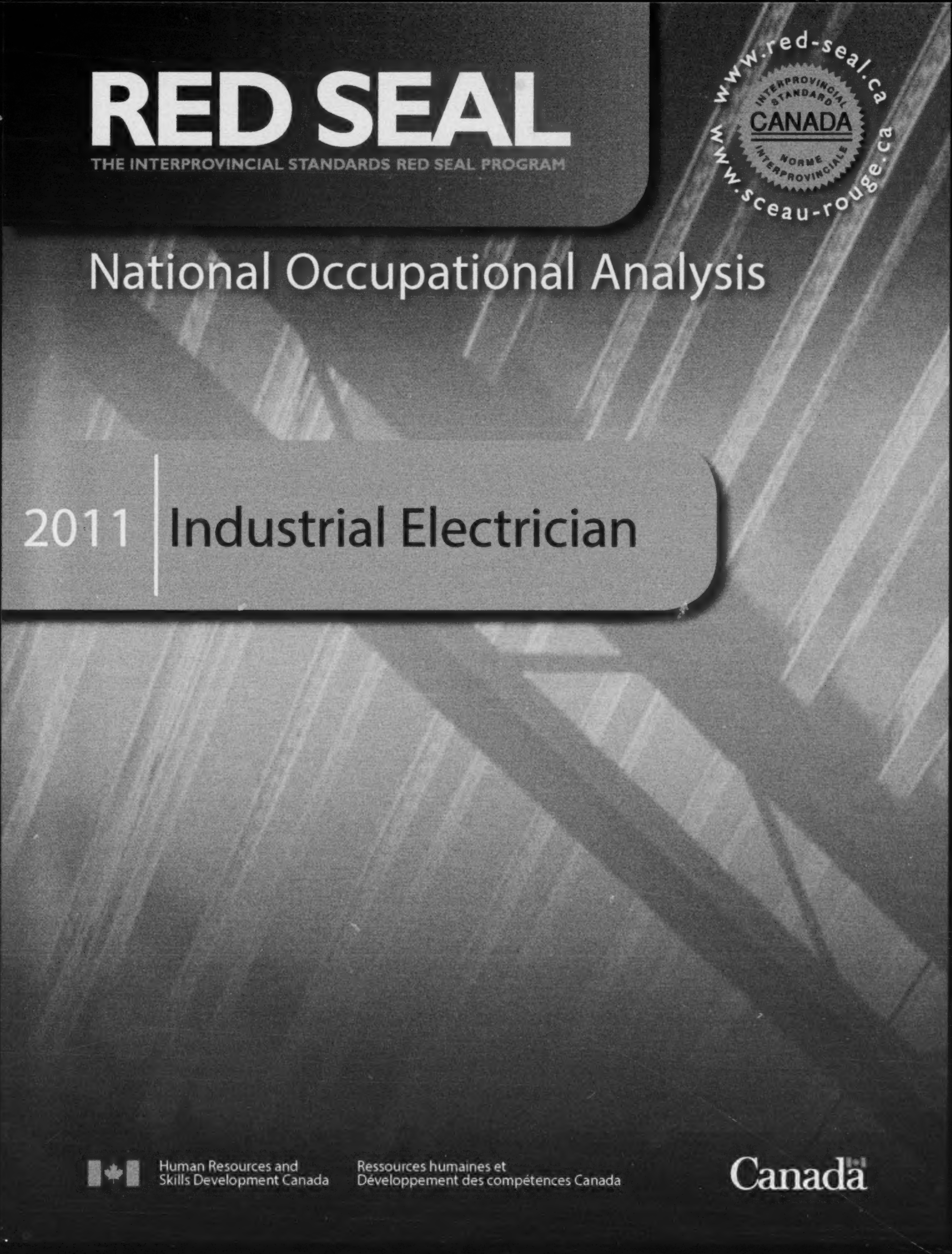

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National Occupational Analysis

2011 | Industrial Electrician

Human Resources and Skills Development Canada
Ressources humaines et Développement des compétences Canada
Canada

Occupational Analyses Series

Industrial Electrician

2011

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FOREWORD

The Canadian Council of Directors of Apprenticeship (CCDA) recognizes this National Occupational Analysis as the national standard for the occupation of Industrial Electrician.

Background

The first National Conference on Apprenticeship in Trades and Industries, held in Ottawa in 1952, recommended that the federal government be requested to cooperate with provincial and territorial apprenticeship committees and officials in preparing analyses of a number of skilled occupations. To this end, Human Resources and Skills Development Canada (HRSDC) sponsors a program, under the guidance of the CCDA, to develop a series of National Occupational Analyses (NOAs).

The NOAs have the following objectives:

- to describe and group the tasks performed by skilled workers;
- to identify which tasks are performed in every province and territory;
- to develop instruments for use in the preparation of Interprovincial Red Seal Examinations and curricula for training leading to the certification of skilled workers;
- to facilitate the mobility of apprentices and skilled workers in Canada; and,
- to supply employers, employees, associations, industries, training institutions and governments with analyses of occupations.

ACKNOWLEDGEMENTS

The CCDA and HRSDC wish to express sincere appreciation for the contribution of the many tradespersons, industrial establishments, professional associations, labour organizations, provincial and territorial government departments and agencies, and all others who contributed to this publication.

Special acknowledgement is extended by HRSDC and the CCDA to the following representatives from the trade.

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This analysis was prepared by the Workplace Partnerships Directorate of HRSDC. The coordinating, facilitating and processing of this analysis were undertaken by employees of the NOA development team of the Trades and Apprenticeship Division. Loreen Barbour for the host jurisdiction of Ontario also participated in the development of this NOA.

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LIST OF PUBLISHED NATIONAL OCCUPATIONAL ANALYSES

(Red Seal Trades)

TITLE	NOC* Code
Agricultural Equipment Technician (2007)	7312
Appliance Service Technician (2011)	7332
Automotive Painter (2009)	7322
Automotive Service Technician (2009)	7321
Baker (2006)	6252
Boilermaker (2008)	7262
Bricklayer (2007)	7281
Cabinetmaker (2007)	7272
Carpenter (2010)	7271
Concrete Finisher (2006)	7282
Construction Craft Worker (2009)	7611
Construction Electrician (2008)	7241
Cook (2008)	6242
Electrical Rewind Mechanic (1999)	7333
Electronics Technician – Consumer Products (1997)	2242
Floorcovering Installer (2005)	7295
Glazier (2008)	7292
Hairstylist (2009)	6271
Heavy Duty Equipment Technician (2009)	7312
Industrial Electrician (2011)	7242
Industrial Mechanic (Millwright) (2009)	7311
Instrumentation and Control Technician (2010)	2243
Insulator (Heat and Frost) (2007)	7293
Ironworker (Generalist) (2010)	7264
Ironworker (Reinforcing) (2010)	7264
Ironworker (Structural/Ornamental) (2010)	7264
Landscape Horticulturist (2010)	2225

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* National Occupational Classification

TITLE	NOC* Code
Lather (Interior Systems Mechanic) (2007)	7284
Machinist (2010)	7231
Metal Fabricator (Fitter) (2008)	7263
Mobile Crane Operator (2009)	7371
Motorcycle Mechanic (2006)	7334
Motor Vehicle Body Repairer (Metal and Paint) (2010)	7322
Oil Heat Systems Technician (2006)	7331
Painter and Decorator (2007)	7294
Partsperson (2010)	1472
Plumber (2010)	7251
Powerline Technician (2009)	7244
Recreation Vehicle Service Technician (2006)	7383
Refrigeration and Air Conditioning Mechanic (2009)	7313
Rig Technician (2008)	8232
Roofer (2006)	7291
Sheet Metal Worker (2010)	7261
Sprinkler System Installer (2009)	7252
Steamfitter/Pipefitter (2010)	7252
Tilesetter (2010)	7283
Tool and Die Maker (2010)	7232
Transport Trailer Technician (2008)	7321
Truck and Transport Mechanic (2010)	7321
Welder (2009)	7265

Requests for printed copies of National Occupational Analyses may be forwarded to:

Trades and Apprenticeship Division
Workplace Partnership Directorate
Human Resources and Skills Development Canada
140 Promenade du Portage, Phase IV, 5th Floor
Gatineau, Quebec K1A 0J9

These publications can be ordered or downloaded online at: www.red-seal.ca. Links to Essential Skills Profiles for some of these trades are also available on this website.

STRUCTURE OF ANALYSIS

To facilitate understanding of the occupation, the work performed by tradespersons is divided into the following categories:

Blocks	largest division within the analysis that is comprised of a distinct set of trade activities
Tasks	distinct actions that describe the activities within a block
Sub-Tasks	distinct actions that describe the activities within a task
Key Competencies	activities that a person should be able to do in order to be called "competent" in the trade

The analysis also provides the following information:

Trends	changes identified that impact or will impact the trade including work practices, technological advances, and new materials and equipment
Related Components	list of products, items, materials and other elements relevant to the block
Tools and Equipment	categories of tools and equipment used to perform all tasks in the block; these tools and equipment are listed in Appendix A
Context	information to clarify the intent and meaning of tasks
Required Knowledge	elements of knowledge that an individual must acquire to adequately perform a task

The appendices located at the end of the analysis are described as follows:

Appendix A — Tools and Equipment	non-exhaustive list of tools and equipment used in this trade
Appendix B — Glossary	definitions or explanations of selected technical terms used in the analysis
Appendix C — Acronyms	list of acronyms used in the analysis with their full name
Appendix D — Block and Task Weighting	block and task percentages submitted by each jurisdiction, and the national averages of these percentages; these national averages determine the number of questions for each block and task in the Interprovincial exam
Appendix E — Pie Chart	graph which depicts the national percentages of exam questions assigned to blocks
Appendix F — Task Profile Chart	chart which outlines graphically the blocks, tasks and sub-tasks of this analysis

DEVELOPMENT AND VALIDATION OF ANALYSIS

Development of Analysis

A draft analysis is developed by a committee of industry experts in the field led by a team of facilitators from HRSDC. This draft analysis breaks down all the tasks performed in the occupation and describes the knowledge and abilities required for a tradesperson to demonstrate competence in the trade.

Draft Review

The NOA development team then forwards a copy of the analysis and its translation to provincial and territorial authorities for a review of its content and structure. Their recommendations are assessed and incorporated into the analysis.

Validation and Weighting

The analysis is sent to all provinces and territories for validation and weighting. Participating jurisdictions consult with industry to validate and weight the document, examining the blocks, tasks and sub-tasks of the analysis as follows:

BLOCKS	Each jurisdiction assigns a percentage of questions to each block for an examination that would cover the entire trade.
TASKS	Each jurisdiction assigns a percentage of exam questions to each task within a block.
SUB-TASKS	Each jurisdiction indicates, with a YES or a NO, whether or not each sub-task is performed by skilled workers within the occupation in its jurisdiction.

The results of this exercise are submitted to the NOA development team who then analyzes the data and incorporates it into the document. The NOA provides the individual jurisdictional validation results as well as the national averages of all responses. The national averages for block and task weighting guide the Interprovincial Red Seal Examination plan for the trade.

This method for the validation of the NOA also identifies common core sub-tasks across Canada for the occupation. If at least 70% of the responding jurisdictions perform a sub-task, it shall be considered common core. Interprovincial Red Seal Examinations are based on the common core sub-tasks identified through this validation process.

Definitions for Validation and Weighting

YES	sub-task performed by qualified workers in the occupation in a specific jurisdiction
NO	sub-task not performed by qualified workers in the occupation in a specific jurisdiction
NV	analysis Not Validated by a province/territory
ND	trade Not Designated in a province/territory
NOT COMMON CORE (NCC)	sub-task, task or block performed by less than 70% of responding jurisdictions; these will not be tested by the Interprovincial Red Seal Examination for the trade
NATIONAL AVERAGE %	average percentage of questions assigned to each block and task in Interprovincial Red Seal Examination for the trade

Provincial/Territorial Abbreviations

NL	Newfoundland and Labrador
NS	Nova Scotia
PE	Prince Edward Island
NB	New Brunswick
QC	Quebec
ON	Ontario
MB	Manitoba
SK	Saskatchewan
AB	Alberta
BC	British Columbia
NT	Northwest Territories
YT	Yukon Territory
NU	Nunavut

ANALYSIS

SAFETY

Safe working procedures and conditions, accident prevention, and the preservation of health are of primary importance to industry in Canada. These responsibilities are shared and require the joint efforts of government, employers and employees. It is imperative that all parties are aware of circumstances and conditions that may lead to injury or harm. Safe learning experiences and work environments can be created by controlling the variables and behaviours that may contribute to accidents or injury.

It is generally recognized that safety-conscious attitudes and work practices contribute to a healthy, safe and accident-free work environment.

It is imperative to apply and be familiar with the Occupational Health and Safety (OH&S) Acts and Workplace Hazardous Materials Information System (WHMIS) regulations. As well, it is essential to determine workplace hazards and take measures to protect oneself, co-workers, the public and the environment.

Safety education is an integral part of training in all jurisdictions. As safety is an imperative part of all trades, it is assumed and therefore it is not included as a qualifier of any activities. However, the technical safety tasks and sub-tasks specific to the trade are included in this analysis.

SCOPE OF THE INDUSTRIAL ELECTRICIAN TRADE

"Industrial Electrician" is this trade's official Red Seal occupational title approved by the CCDA. This analysis covers tasks performed by industrial electricians whose occupational title has been identified by some provinces and territories of Canada under the following names:

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
Electrician (Non-Construction)					✓								
Industrial Electrician	✓	✓	✓	✓		✓	✓			✓		✓	

Industrial electricians install, maintain, test, troubleshoot, service and repair industrial electrical equipment and associated electrical controls. These include equipment or components directly or indirectly exposed to electrical power such as motors, generators, pumps and lighting systems. Industrial electricians are employed by electrical contractors and maintenance departments of factories, plants, mines, fabrication facilities and government, and other industrial establishments.

Industrial electricians must read and interpret prints, drawings and code specifications for layout and installation of electrical equipment. They install, service and maintain electrical components such as lighting fixtures, switches, conduit and electrical controls. They test electrical systems and continuity of circuits using test equipment to ensure system safety and compatibility. They conduct preventative and predictive maintenance programs and keep maintenance records. Some industrial electricians specialize in maintenance functions in areas such as high voltage and process controls.

Industrial electricians must possess manual dexterity, and good planning, organizational and communication skills. They also require strong analytical, mathematical and problem-solving skills in order to read and interpret schematics, drawings and specifications. They should have good mechanical aptitude to install, troubleshoot and repair equipment. They must also have good vision and hearing, the ability to distinguish colours and a willingness to keep up with new developments in the trade.

The work environment of industrial electricians can expose them to hazards. Their work is performed indoors or outdoors in extreme climate conditions, and may be at variable heights or in confined spaces. Other occupational risks include electrical shocks, arc flashes, falls, and injury from lifting and kneeling.

This analysis recognizes similarities or overlaps with the work of construction electricians, powerline technicians, instrumentation and control technicians, electric motor systems technicians, heating, ventilation and air conditioning (HVAC) technicians, telecommunications technicians and industrial mechanics (millwrights). Industrial electricians also work with process operators, engineers and inspectors.

With experience, industrial electricians may act as mentors and trainers to apprentices in the trade. They may also advance to managerial, inspection or teaching positions.

OCCUPATIONAL OBSERVATIONS

Technological advancements have altered the way industrial electricians perform their work on a daily basis. Computers are increasingly being used for research, communication, programming, ordering, record keeping and diagnostics. Testing equipment is becoming more precise and user-friendly allowing for troubleshooting to be less time consuming.

In the maintenance of industrial electrical equipment and systems, inspection is evolving into a more critical area of focus. In fact, inspection is gaining more importance in assuring the health and safety of employees and the continued smooth and safe operation of machinery and components.

The combination of various factors in the presence of a fault may cause an arc flash, an extreme explosion, which could result in serious injury or death. Injuries caused by arc flash have led to heightened safety measures. New practices, procedures, safety equipment and jurisdictional regulations have been created and implemented in order to address the issue.

Predictive and preventative maintenance programs, using computerized maintenance management systems (CMMSs), are becoming more prevalent in the workplace. These systems have enhanced efficiency and organization of the tasks required for maintenance of electrical systems. They also centralize other functions such as trends, component ordering, project control, history, costing, work hours and tool cribs.

Programmable logic controllers (PLCs) and distributed control systems (DCSs) facilitate the monitoring and control of industrial processes and building controls. This equipment has become more user-friendly and affordable. Smaller units are readily available for a variety of applications.

Digital technology has facilitated the use of new components, making the tracking of energy usage more reliable and efficient. It is simpler to replace many of the old parts and devices now that they are smaller and available in digital format.

In many sectors of industry, robotic technology is being utilized. Therefore, some industrial electricians are now required to develop specialized skills to keep abreast of this new technology.

The workload for industrial electricians has increased in process control, environmental control and building control systems. There is now an increased emphasis on accountability for safety in the workplace.

ESSENTIAL SKILLS SUMMARY

Essential skills are needed for work, learning and life. They provide the foundation for learning all other skills and enable people to evolve with their jobs and adapt to workplace change.

Through extensive research, the Government of Canada and other national and international agencies have identified and validated nine essential skills. These skills are used in nearly every occupation and throughout daily life in different ways.

A series of CCDA-endorsed tools have been developed to support apprentices in their training and to be better prepared for a career in the trades. The tools can be used independently or with the assistance of a tradesperson, trainer, employer, teacher or mentor to:

- understand how essential skills are used in the trades;
- learn about individual essential skills strengths and areas for improvement; and
- improve essential skills and increase success in an apprenticeship program.

The tools are available online or for order at: www.hrsdc.gc.ca/essentialskills.

The essential skills profile for the industrial electrician trade indicates that the most important essential skills are **document use**, **thinking skills** such as **problem solving** and **computer use**. Industrial electricians attending the NOA workshop also identified **numeracy** as being very important for this trade.

The application of these skills may be described throughout this document within the competency statements which support each subtask of the trade. The following are summaries of the requirements in each of the essential skills, taken from the essential skills profile. A link to the complete essential skills profile can be found at www.red-seal.ca.

Reading
In their daily work, industrial electricians read and comprehend several types of text. These include safety and workplace documents and work orders as well as more complex technical electrical codes, regulations and equipment manuals.

Document Use
Industrial electricians must use workplace documents such as electrical diagrams and schematic drawings, Material Safety Data Sheets (MSDS) and shift schedules. They must be familiar with electrical codes. It is necessary for industrial electricians to seek service and repair information online.

Writing

Industrial electricians use writing skills to record comments or notes in logbooks or work records. They write messages to colleagues or management to give work details or reply to requests for technical information. They also write longer service reports to describe problems and their solutions.

Oral Communication

Industrial electricians use oral communication skills to coordinate work with production crews and equipment operators. Clear communication of technical and complex information is very important to avoid injuries and promote efficiency. Industrial electricians also use communication skills working with co-workers and supervisors, and mentoring apprentices in the trade. Good listening skills are also required of industrial electricians for comprehension and understanding such as the ability to repeat back clearly what has been stated or learned.

Numeracy

Industrial electricians use a range of complex math skills in their day-to-day work. These include scheduling, measurement, conversions and calculations. They use electrical theory by applying formulas from electrical codes to determine equipment and wiring specifications and to analyze measurements.

Thinking Skills

Industrial electricians require strong analytical skills to troubleshoot and diagnose malfunctions in equipment. They use logic and memory to determine the faults. They must use decision-making skills to perform work planning and prioritizing. Decisions about when to perform shut-downs have important implications on safety in their workplace.

Industrial electricians organize the most effective use of their time within the framework of assigned tasks. Routine tasks are generally assigned by supervisors or dictated by a procedure established by the employer. Much of their other work is in response to broken or malfunctioning equipment. They often have to re-prioritize tasks several times a day. Industrial electricians coordinate their work with other trades and production staff, all of whom have different needs and priorities.

Working with Others

Industrial electricians work as part of a team that includes other tradespeople and professionals to install, repair and maintain industrial electrical systems and equipment. They most often work independently, co-ordinating their work with the work of others, but for large jobs they work with a partner or crew.

Computer Use

Computer skills are increasingly important for industrial electricians. They use general applications such as e-mails, Internet, word processing, databases and original equipment manufacturer (OEM) software to communicate, perform research and organize their work. More trade-specific applications include computer assisted design (CAD) and computer-aided manufacturing (CAM) software and logic controllers.

Continuous Learning

Industrial electricians often receive in-house safety training to update their certifications such as WHMIS, transportation of dangerous goods (TDG), First Aid and cardiopulmonary resuscitation (CPR). They also receive training so that they can safely operate equipment such as forklifts, scissor lifts and scaffolding. They learn about new equipment on the job by reading manuals, taking courses and through hands-on experience. They obtain computer training by taking courses off-site and through e-learning.

Trends

Although arc flash has always been recognized as a hazard, nowadays, more training is required for industrial electricians. The use of additional personal protective equipment (PPE) such as gloves, hoods and poles is also required to match the rating of the arc flash potential. Less work is performed on energized equipment, due to the arc flash regulations.

Related Components

All components apply.

Tools and Equipment

See Appendix A.

Task 1 Performs safety-related functions.

Context

Safety is extremely important in the work of industrial electricians. While all tasks in this analysis must be performed safely, this task describes activities that are performed specifically to promote a safe workplace.

Required Knowledge

K 1	OH&S regulations
K 2	WHMIS symbols and MSDS
K 3	workers' rights and responsibilities
K 4	company and site safety policies and procedures
K 5	site-specific fire safety and work permit procedures
K 6	emergency procedures such as for evacuation, fire and hazardous chemical alarms
K 7	location of on-site first aid stations and equipment
K 8	types of PPE such as hard hats, safety glasses, safety footwear, insulating gloves, arc flash equipment, and fall arrest and respiratory protection equipment
K 9	Canadian Standards Association (CSA) approved equipment
K 10	types of safety equipment such as first aid kits, fire extinguishers and eye wash stations
K 11	certification and training requirements for PPE and safety equipment

K 12	jurisdictional certification and training requirements
K 13	types and operation of fire extinguishing equipment
K 14	location of PPE and safety equipment
K 15	shelf life of PPE and safety equipment
K 16	confined space procedures
K 17	TDG regulations
K 18	lock-out and tagging procedures
K 19	Atomic Energy Control Board (AECB) regulations
K 20	Codes such as building codes, the Canadian Electrical Code (CEC) and jurisdictional codes

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Sub-task

A-1.01 Maintains safe work environment.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

A-1.01.01	perform housekeeping practices
A-1.01.02	identify, report and correct potential and existing hazards such as arc flash
A-1.01.03	test radiation sources using measurement instruments such as Geiger counters
A-1.01.04	test for gasses such as hydrogen sulfide (H_2S) and sulfur dioxide (SO_2) according to site policy and local regulations
A-1.01.05	calibrate gas monitors according to safety regulations
A-1.01.06	inform surrounding co-workers concerning safety and well-being
A-1.01.07	safely store materials and equipment
A-1.01.08	identify and respect physical limitations of self and others
A-1.01.09	set up or identify location of safety zone containing components such as first aid kits, fire extinguishers, MSDS and eye wash stations
A-1.01.10	document items such as inspections, potential hazards, safety meetings, injuries and training according to jurisdictional regulations
A-1.01.11	attend tool box meetings

Sub-task

A-1.02 Uses personal protective equipment (PPE) and safety equipment.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

A-1.02.01	identify site hazards and regulations requiring the use of PPE and safety equipment
A-1.02.02	locate and select PPE and safety equipment such as arc flash clothing, fire extinguishers and signage appropriate for individual tasks and situations
A-1.02.03	ensure proper fit of PPE such as respirators and face shields
A-1.02.04	recognize worn, damaged or defective PPE and safety equipment such as excessively worn boots and cracked safety glasses
A-1.02.05	report and replace damaged or faulty equipment
A-1.02.06	organize, clean and store PPE and safety equipment according to OEM specifications
A-1.02.07	apply safety regulations such as WHMIS and OH&S

Sub-task

A-1.03 Performs lock-out and tagging procedures.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

A-1.03.01	coordinate lock-out and tagging requirements with appropriate authorities and other trades
A-1.03.02	identify equipment for lock-out and tagging
A-1.03.03	select approved locks and tags
A-1.03.04	perform bump test on energized equipment to ensure work will be performed on correct piece of equipment
A-1.03.05	de-energize equipment and perform bump test to confirm de-energization
A-1.03.06	test system for zero potential using equipment such as voltmeters and high voltage testers
A-1.03.07	verify proper lock-out and tagging

Task 2 Uses and maintains tools and equipment.

Context Industrial electricians must have the ability to select, use and maintain the appropriate tools and equipment for specific tasks.

Required Knowledge

K 1	types and limitations of hand tools such as screwdrivers, pliers, wrenches and measuring tapes
K 2	types, functions, capabilities, limitations and operating procedures of portable pneumatic, electric and hydraulic power tools
K 3	types, functions, capabilities, limitations and operating procedures of stationary power tools such as drill presses, bench grinders and belt sanders
K 4	types, functions, capabilities, limitations and operating procedures of powder-actuated tools
K 5	fastener specifications for powder-actuated tools
K 6	training and certification requirements to operate powder-actuated tools
K 7	powder-actuated tool components
K 8	types and operating procedures of mechanical measuring equipment such as micrometers, torque wrenches and feeler gauges
K 9	types, functions, capabilities, limitations and operating procedures of equipment used for measuring high voltage and/or frequency
K 10	types, functions, applications, limitations and ratings of electrical testing and diagnostic tools such as multimeters, voltage testers, non-contact voltage testers, megohmmeters and clamp ammeters
K 11	electrical testing and diagnostic tool accessories such as leads, fuses and batteries
K 12	maintenance schedules
K 13	environmental factors that affect readings
K 14	OEM specifications for operating and maintenance instructions, and for calibration schedules
K 15	types of access equipment such as scissor lifts, platform lifts and articulated boom lifts
K 16	types of scaffolding such as tubular and frame
K 17	capabilities and limitations of scaffolding and access equipment
K 18	load bearing capacity of access equipment
K 19	certification requirements and regulations for scaffolding and access equipment
K 20	fall protection requirements when working on access equipment

K 21	safe angles of ladders
K 22	three-point contact rule
K 23	work site surroundings such as trenching, pits and overhead hazards
K 24	types, functions, operating procedures, techniques, and limitations of rigging, tugging, hoisting and lifting equipment
K 25	certification requirements regarding rigging, tugging, hoisting and lifting equipment
K 26	anchor points
K 27	load ratings

Sub-task

A-2.01 Maintains tools and equipment.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

A-2.01.01	organize and store tools and components according to OEM specifications
A-2.01.02	clean, sharpen, lubricate and adjust tools to OEM specifications
A-2.01.03	ensure calibration of measuring equipment to OEM specifications
A-2.01.04	identify worn, damaged or defective tools
A-2.01.05	change tool components such as chucks, bits and blades
A-2.01.06	replace tool components such as cords, attachment plugs and air lines
A-2.01.07	repair tools according to OEM specifications
A-2.01.08	identify hazards associated with tools

Sub-task

A-2.02 **Uses access equipment.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

A-2.02.01	identify traffic areas and potential hazards such as confined spaces and trenches
A-2.02.02	install barricades and signage to contain work zone if required
A-2.02.03	select access equipment such as ladders, scissor lifts and articulated boom lifts
A-2.02.04	set up and secure step ladders and extension ladders
A-2.02.05	erect various types of scaffolding if required
A-2.02.06	visually and mechanically inspect for worn, damaged or defective scaffolding and access equipment according to OEM specifications
A-2.02.07	report, tag and decommission unsafe, worn, damaged or defective scaffolding and access equipment
A-2.02.08	organize and store access equipment according to OEM specifications

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Sub-task

A-2.03 **Uses rigging, tugging, hoisting and lifting equipment.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

A-2.03.01	identify traffic areas and potential hazards such as confined spaces and trenches
A-2.03.02	install barricades and signage to contain work zone
A-2.03.03	use and understand hand signals
A-2.03.04	select and secure rigging, tugging, hoisting and lifting equipment according to application
A-2.03.05	ensure calibration of rigging, tugging, hoisting and lifting equipment according to OEM specifications and jurisdictional regulations
A-2.03.06	visually and mechanically inspect for worn, damaged or defective rigging, tugging, hoisting and lifting equipment according to OEM specifications

A-2.03.07	report, tag and decommission unsafe, worn, damaged or defective rigging, tugging, hoisting and lifting equipment
A-2.03.08	secure load for application according to jurisdictional regulations and company policy
A-2.03.09	clean, lubricate and store rigging, tugging, hoisting and lifting equipment
A-2.03.10	perform minor field repairs and replenish fluid levels

Task 3 Organizes work.

Context Organizing work allows industrial electricians to interpret, locate and modify documentation, as well as organize necessary materials, plan project tasks and prepare the work site in order to do their jobs safely and effectively.

Required Knowledge

K 1	codes such as building codes, the CEC and jurisdictional codes
K 2	OH&S regulations
K 3	standards such as CSA and Underwriters' Laboratories of Canada (ULC)
K 4	code and regulation updates
K 5	features of plans, schematics, drawings and specifications such as scale, legend, details, abbreviations and symbols
K 6	standard symbol and drawing conventions
K 7	CAD systems
K 8	documentation requirements for modifying drawings
K 9	types of documentation such as manuals, work orders, preventative maintenance sheets, regulations, technical bulletins, shop drawings and catalogues
K 10	company policies and procedures
K 11	types of equipment
K 12	WHMIS symbols and MSDS
K 13	OEM specifications
K 14	trade terminology
K 15	project or task to be completed
K 16	work site location, conditions and restrictions
K 17	delivery dates, inventory control and availability of materials
K 18	sequence of operations
K 19	building structures such as walls, ceilings and floors

K 20	equipment such as panel boards, switchgear and motor control centres (MCCs)
K 21	work site hazards such as existing utilities, dust, temperature, chemicals and weather
K 22	CMMSs

Sub-task

A-3.01 Interprets codes and regulations.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

A-3.01.01	access codes and regulations such as CEC, TP127, municipal and local codes
A-3.01.02	refer to codes and regulations to locate information
A-3.01.03	apply codes and regulations according to application
A-3.01.04	remain up-to-date with modifications and changes to codes and regulations

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Sub-task

A-3.02 Uses plans, schematics, drawings and specifications.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

A-3.02.01	cross reference plans, drawings and specifications
A-3.02.02	locate information on plans, drawings and specifications
A-3.02.03	scale dimensions
A-3.02.04	interpret three-dimensional structures and circuits
A-3.02.05	perform mathematical calculations such as conduit fill, and single- and three-phase circuit calculations
A-3.02.06	apply schematics and wiring diagrams to perform tasks such as troubleshooting, maintaining and installing systems
A-3.02.07	determine whether plans, schematics and drawings are up-to-date according to as-built

A-3.02.08	modify and produce as-built plans, schematics and drawings to reflect change brought to application
A-3.02.09	document changes made to equipment and wiring

Sub-task

A-3.03 Selects materials and supplies.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

A-3.03.01	identify required materials and supplies according to application, plans, specifications, codes and environment
A-3.03.02	perform mathematical calculations such as scaling, ratios and determining segment lengths of cabling and wiring
A-3.03.03	interpret site measurements and instructions
A-3.03.04	quantify materials according to plans
A-3.03.05	perform inventory control
A-3.03.06	order materials and supplies

Sub-task

A-3.04 Plans project tasks and procedures.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

A-3.04.01	visually inspect work environment to determine scope of work
A-3.04.02	determine labour and equipment requirements according to specifications such as wire sizes, load requirements and locations
A-3.04.03	establish and maintain assigned schedules
A-3.04.04	coordinate work with other trades such as shutdown requirements and installation sequencing
A-3.04.05	draw and sketch layouts
A-3.04.06	follow installation and operational sequences

Sub-task

A-3.05 Prepares work site.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

A-3.05.01	visually inspect to identify traffic areas and potential hazards such as confined spaces and trenches
A-3.05.02	install barricades and signage to contain work zone
A-3.05.03	create openings and penetrations in structures and equipment
A-3.05.04	ensure sufficient lighting and ventilation of work area
A-3.05.05	ensure all required materials and equipment are on-site

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Sub-task

A-3.06 Documents maintenance work.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

A-3.06.01	retrieve, record and interpret test data for future reference
A-3.06.02	record faults and failed components to aid in diagnosis
A-3.06.03	record service performed and required repairs to keep a log on that piece of equipment
A-3.06.04	record corrective actions to speed up repairs and to monitor equipment trends
A-3.06.05	record date and parts used to replace or repair defective or recalled devices, to keep a log on that piece of equipment and for budgeting purposes
A-3.06.06	record identified potential and existing hazards for safety purposes and to help prioritize the work
A-3.06.07	record modifications for inspection purposes from local authorities, to repeat successful modification on other common pieces of equipment and for troubleshooting purposes
A-3.06.08	identify and record work needed to be performed to prioritize the tasks

A-3.06.09	record industry alerts to replace or repair defective or recalled devices
A-3.06.10	record calibration data as found and as left for auditing purposes

Task 4 Performs routine trade activities.

Context These are activities that are performed throughout the trade. Industrial electricians perform these tasks in a safe and efficient manner. These tasks identify specific skills and functions that are typically performed by industrial electricians in the normal course of their work.

Required Knowledge

K 1	electrical classification of work site location
K 2	building structures such as walls, ceilings and floors
K 3	equipment such as panel boards, switchgear and MCCs
K 4	work site hazards such as existing utilities, explosive atmosphere, dust, temperature, chemicals and weather
K 5	impact of performing task during process operations
K 6	start-up and commissioning procedures such as rotational testing, voltage readings and current readings
K 7	required documentation
K 8	OEM specifications
K 9	sequence of operation of equipment
K 10	types, styles, purposes and sizes of fasteners, fittings and connectors such as expansion joints, explosion proof and water proof
K 11	installation and replacement procedures, and capabilities and limitations of fasteners, fittings and connectors
K 12	fire stopping techniques

Sub-task

A-4.01 Installs fasteners, fittings and connectors.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

A-4.01.01	select and use tools and equipment such as hand tools, threaders, pipe wrenches, knock-out sets, step drills, hole saws and welding equipment
A-4.01.02	determine thread size according to size of raceway
A-4.01.03	cut and thread fittings according to measurements of installation
A-4.01.04	select fasteners, fittings, ground bushings and connectors to match the installation requirements, and verify compatibility according to engineered drawings, electrical classification of work site and environment such as underground and wet location
A-4.01.05	locate and mount fasteners, fittings, ground bushings and connectors, and ensure accessibility of fittings according to installation requirements
A-4.01.06	torque and tighten fasteners and connectors to engineered specifications
A-4.01.07	apply lubricant, sealant, anti-seize and anti-oxidant compounds according to engineering specifications and industry practices

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Sub-task

A-4.02 Conducts operational tests.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

A-4.02.01	select and use tools and equipment such as multimeters, hand tools, scope meters and calibrators
A-4.02.02	perform sensory inspection to check for ambient temperature, abnormal heat, equipment damage, and presence of corrosion, smoke or unusual odours
A-4.02.03	take measurements such as voltages, current, frequency, temperature, speed and pressure to verify system operation and parameters
A-4.02.04	retrieve, read and interpret historical data, OEM specifications, and engineered drawings and data to assist in the testing

A-4.02.05	disconnect/reconnect components to allow access to circuitry according to industry practices
A-4.02.06	put the process in Manual mode to prevent upset and to aid in testing procedure, and put back to Automatic upon completion
A-4.02.07	calibrate devices and sensors according to plant requirements
A-4.02.08	compare historical and as found data to interpret tendencies and trends and change maintenance frequency accordingly
A-4.02.09	make calculations and conversions such as power factor and power usage to verify that equipment is working correctly and to aid in the selection of components according to engineering specifications
A-4.02.10	test equipment to specifications such as motor overload protection and adjustable trip mechanism circuit breakers
A-4.02.11	ensure sequencing and safety circuit operation after testing

BLOCK B

POWER DISTRIBUTION AND GENERATING SYSTEMS

Trends

Tidal generation systems are starting to appear. They offer dependable, renewable energy through the oceanic tidal cycle.

Increasingly, industrial establishments are using their own micro-generation systems. These systems are cost-efficient, using the by-products of their operation to produce their own electricity.

Related Components (including, but not limited to)

Disconnects, MCCs, distribution panels, breakers, relays, fuses, overloads, protective relays, capacitors, transformers, contactors, motors, alternators, generators, cables, raceways, cable trays, bus systems, insulators, synchronisers, arrestors, ground rods, grids, solar cell mats, ground fault systems, wind turbines.

Tools and Equipment

See Appendix A.

Task 5 Maintains high voltage power distribution systems.

Context

High voltage power distribution systems are used in power lines, plants and substations for long distance transmission at lower currents. Industrial electricians must be able to install, service and repair these systems in order to ensure their efficient operation and reduce unscheduled disruptions. Maintaining high voltage power systems is among the most hazardous tasks for industrial electricians and extreme caution must be used in these environments.

Required Knowledge

K 1	regulations regarding the installation of high voltage power systems
K 2	types of high voltage power systems
K 3	components such as switchgear, transformers and cabling
K 4	hazards associated with high voltage power systems
K 5	methods and procedures for installing high voltage power systems such as terminations, splicing and testing
K 6	safety procedures to access high voltage environments and equipment

K 7	inspection, maintenance, troubleshooting, repair, replacement and adjustment procedures and OEM specifications
K 8	safety procedures and equipment required to maintain high voltage power systems
K 9	system and component operation
K 10	potential causes of power loss such as phase-to-phase shorts, overcurrent and under frequency
K 11	events that lead to system failure
K 12	performance history of equipment
K 13	preventative and predictive maintenance schedules
K 14	calibration according to OEM specifications for components such as breakers, relays and switchgear

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Sub-task

B-5.01 Installs high voltage power distribution systems. (NOT COMMON CORE)

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	no	yes	no	yes	yes	no	ND	ND	yes	ND	NV	ND

Key Competencies

B-5.01.01	select and use tools and equipment such as wrenches, knives and pliers
B-5.01.02	ensure proper egress around distribution system according to code requirements
B-5.01.03	assemble and torque components in appropriate locations according to OEM specifications
B-5.01.04	shim and level the cabinets
B-5.01.05	splice and terminate cable according to OEM specifications
B-5.01.06	follow installation procedures and specifications
B-5.01.07	verify system operation

Sub-task

B-5.02 Services high voltage power distribution systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	no	yes	no	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

B-5.02.01	identify hazards of stored energy in capacitors, cabling and transformers
B-5.02.02	de-energize system from all power sources
B-5.02.03	test system for zero potential using high voltage tester
B-5.02.04	apply ground sets to phase conductors to drain capacitance charge
B-5.02.05	select and use tools and equipment such as vacuum cleaners and torque wrenches
B-5.02.06	visually inspect high voltage components for deterioration such as corrosion, corona, loose torque and discolouration
B-5.02.07	select and use diagnostic tools and equipment such as hi-pot testing tools and ultra-sonic detectors
B-5.02.08	identify worn, damaged, defective or hazardous components using methods such as oil samplings
B-5.02.09	identify components that require repair or replacement
B-5.02.10	clean and lubricate components
B-5.02.11	verify system operation

Sub-task

B-5.03 Troubleshoots high voltage power distribution systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	no	yes	no	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

B-5.03.01	identify hazards of stored energy in capacitors, cabling and transformers
B-5.03.02	perform sensory inspection of component deterioration such as corrosion, corona, loose torque and discolouration
B-5.03.03	select and use diagnostic tools and equipment such as hi-pot testing tools, thermal graphic cameras and ultra-sonic detectors
B-5.03.04	isolate faults by de-energizing source of energy

B-5.03.05	test system for zero potential using high voltage tester
B-5.03.06	apply ground sets to phase conductors to drain capacitance charge
B-5.03.07	identify worn, damaged, defective or hazardous components using methods such as oil samplings

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Sub-task

B-5.04 Repairs high voltage power distribution systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	no	yes	no	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

B-5.04.01	identify hazards of stored energy in capacitors, cabling and transformers
B-5.04.02	determine whether components require repair or replacement
B-5.04.03	select and use tools and equipment such as torque wrenches, pliers and knives
B-5.04.04	select replacement components according to OEM specifications and code requirements
B-5.04.05	de-energize system from all power sources
B-5.04.06	test system for zero potential using high voltage tester
B-5.04.07	apply ground sets to phase conductors to drain capacitance charge
B-5.04.08	disassemble/reassemble components according to OEM specifications to access repair area
B-5.04.09	replace, adjust and modify components such as bushings and switches
B-5.04.10	clean components before terminating to ensure good contact and continuity
B-5.04.11	verify operation of components

Task 6 Maintains low voltage power distribution systems.

Context	Low voltage power distribution systems provide power to the plant. Industrial electricians must be able to install, service and repair these systems in order to ensure their efficient operation and reduce unscheduled disruptions.

Required Knowledge

K 1	codes and regulations regarding the installation of low voltage power systems
K 2	types of low voltage power systems, single- and three-phase
K 3	types of components such as disconnects, MCCs, power transformers and cabling
K 4	installation, inspection, maintenance, testing, troubleshooting and repair procedures and specifications
K 5	rating, sizing and compatibility of components such as bus bars, breakers, fuses and distribution panels
K 6	hazards associated with low voltage power systems
K 7	system and component operation
K 8	events that lead to system failure
K 9	performance history of equipment
K 10	safety procedures required for service and repair

Sub-task

B-6.01 Installs low voltage power distribution systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	no	ND	ND	yes	ND	NV	ND

Key Competencies

B-6.01.01	select and use tools and equipment such as phase meters, compression tools, wire strippers and benders
B-6.01.02	ensure proper egress around distribution system according to code requirements
B-6.01.03	perform phasing to achieve required rotation of three-phase rotating equipment

B-6.01.04	assemble and torque components in appropriate locations according to OEM specifications
B-6.01.05	shim and level the cabinets
B-6.01.06	terminate cable according to code requirements
B-6.01.07	follow installation procedures according to OEM specifications
B-6.01.08	verify system operation

Sub-task

B-6.02 Services low voltage power distribution systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

B-6.02.01	select and use diagnostic tools and equipment such as megohmmeters and multimeters
B-6.02.02	identify hazards of stored energy in capacitors
B-6.02.03	de-energize system from all power sources
B-6.02.04	test system for zero potential using multimeter
B-6.02.05	select and use tools and equipment such as vacuum cleaners and torque wrenches
B-6.02.06	visually inspect components for deterioration such as corrosion, loose torque and discolouration using methods such as thermography for hot spots
B-6.02.07	identify components that require repair or replacement
B-6.02.08	clean and lubricate components
B-6.02.09	perform adjustments such as trip settings and tap changes
B-6.02.10	verify system operation

Sub-task

B-6.03 Troubleshoots low voltage power distribution systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

B-6.03.01	select and use diagnostic tools and equipment such as multimeters, clamp-on ammeters and megohmmeters
B-6.03.02	identify hazards of stored energy in capacitors according to indicators such as hazard stickers or drawings
B-6.03.03	visually inspect components for deterioration such as corrosion, loose torque and discolouration
B-6.03.04	isolate faults by de-energizing source of energy
B-6.03.05	de-energize system from all power sources
B-6.03.06	test system for zero potential using multimeter
B-6.03.07	identify components that require repair or replacement

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Sub-task

B-6.04 Repairs low voltage power distribution systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

B-6.04.01	select and use tools and equipment such as screwdrivers, wrenches and pliers
B-6.04.02	determine whether components require repair or replacement
B-6.04.03	select replacement components such as relays, contactors and fuses according to OEM specifications and code requirements
B-6.04.04	de-energize system from all power sources
B-6.04.05	disassemble/reassemble components according to OEM specifications
B-6.04.06	replace, adjust and modify components such as relays, contactors and fuses
B-6.04.07	test system for zero potential using multimeter
B-6.04.08	identify hazards of stored energy in capacitors, cabling and transformers
B-6.04.09	clean components before terminating to ensure good contact and continuity
B-6.04.10	verify operation of components

Task 7 Maintains alternating current (AC) systems.

Context	AC systems are used to supply load power to branch circuit equipment. Therefore, it is important to maintain these systems by installing upgrades, performing preventative maintenance and making necessary repairs in an expedient manner.

Required Knowledge

K 1	codes and regulations regarding the installation of AC systems
K 2	types of AC systems such as single- and three-phase
K 3	AC system components, controls, capabilities and specifications
K 4	component operation
K 5	OEM installation, maintenance, inspection, troubleshooting and repair specifications
K 6	load balancing
K 7	power factor correction
K 8	line and low voltage controls
K 9	events that lead to system failure
K 10	performance history of equipment
K 11	preventative maintenance techniques, tests and procedures

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Sub-task

B-7.01 Installs alternating current (AC) systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

B-7.01.01	select and use tools and equipment such as wrenches, wire strippers and pliers
B-7.01.02	ensure proper egress around distribution system according to code requirements
B-7.01.03	determine circuit loading capacity
B-7.01.04	assemble and torque components in appropriate locations according to OEM specifications
B-7.01.05	shim and level the cabinets

B-7.01.06	terminate cable according to code and OEM specifications
B-7.01.07	follow installation procedures according to code and OEM specifications
B-7.01.08	verify system operation

Sub-task

B-7.02 Services alternating current (AC) systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

B-7.02.01	select and use diagnostic tools and equipment such as megohmmeters and multimeters
B-7.02.02	de-energize system from all power sources
B-7.02.03	test system for zero potential using multimeter
B-7.02.04	select and use tools and equipment such as vacuum cleaners and torque wrenches
B-7.02.05	visually inspect components for deterioration such as corrosion, loose torque and discolouration using methods such as thermography for hot spots
B-7.02.06	identify components that require repair or replacement
B-7.02.07	disassemble/reassemble components according to OEM specifications
B-7.02.08	clean and lubricate components
B-7.02.09	perform adjustments such as trip settings and overloads
B-7.02.10	verify system operation

Sub-task

B-7.03 Troubleshoots alternating current (AC) systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

B-7.03.01	select and use diagnostic tools and equipment such as multimeters, clamp-on ammeters and megohmmeters
B-7.03.02	perform sensory inspection of components for deterioration such as corrosion, loose torque and discolouration
B-7.03.03	isolate faults by de-energizing source of energy
B-7.03.04	de-energize system from all power sources
B-7.03.05	test system for zero potential using multimeter
B-7.03.06	disassemble/reassemble components according to OEM specifications
B-7.03.07	identify components such as fuses, breakers and contactors that require repair or replacement

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Sub-task

B-7.04 Repairs alternating current (AC) systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

B-7.04.01	select and use tools and equipment such as screwdrivers, wrenches and pliers
B-7.04.02	determine whether components require repair or replacement
B-7.04.03	select replacement components such as relays, contactors and fuses according to OEM specifications and code requirements
B-7.04.04	de-energize system from all power sources
B-7.04.05	test system for zero potential using multimeter
B-7.04.06	disassemble/reassemble components according to OEM specifications
B-7.04.07	replace, adjust and modify components such as relays, contactors and fuses
B-7.04.08	clean components before terminating to ensure good contact and continuity
B-7.04.09	verify operation of components

Task 8 Maintains direct current (DC) systems.

Context	DC systems provide power to specialized equipment found in industry. Industrial electricians must be able to install, service and repair these systems in order to ensure their efficient operation and reduce unscheduled disruptions.

Required Knowledge

K 1	codes and regulations regarding the installation of DC systems
K 2	types and applications of DC systems such as power, control, cathodic protection and lighting
K 3	rectification and DC power generation
K 4	system and component operation
K 5	rating and compatibility of components such as bus bars, breakers and distribution panels
K 6	hazards associated with DC systems
K 7	OEM specifications for inspection, maintenance, installation, troubleshooting, repair, replacement, adjustment and modification
K 8	specifications, characteristics, types and sizes of DC system components such as brushes, relays, breakers and bus bars
K 9	types and causes of failure of DC system components
K 10	events that lead to system failure
K 11	safety procedures required to troubleshoot, service and repair DC systems
K 12	battery systems and their maintenance requirements

Sub-task

B-8.01 Installs direct current (DC) systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

B-8.01.01	select and use tools and equipment such as wrenches, wire strippers and specific gravity (SG) testers
B-8.01.02	ensure proper egress and ventilation around distribution system according to code requirements
B-8.01.03	determine circuit loading capacity

B-8.01.04	ensure cables are connected according to polarity and grounded as required
B-8.01.05	assemble and torque components in appropriate locations according to OEM specifications
B-8.01.06	shim and level the cabinets
B-8.01.07	terminate cable according to code requirements
B-8.01.08	follow installation procedures according to code and OEM specifications
B-8.01.09	verify system operation

Sub-task

B-8.02 **Services direct current (DC) systems.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

B-8.02.01	select and use diagnostic tools and equipment such as megohmmeters and multimeters
B-8.02.02	de-energize system from all power sources
B-8.02.03	test system for zero potential using multimeter
B-8.02.04	select and use tools and equipment such as vacuum cleaners and torque wrenches
B-8.02.05	perform sensory inspection on components such as generators, commutators and batteries for deterioration such as corrosion, loose torque and discolouration using methods such as thermography for hot spots
B-8.02.06	identify presence of power anomalies such as ripple, noise and spikes
B-8.02.07	identify components that require repair or replacement
B-8.02.08	disassemble/reassemble components according to OEM specifications
B-8.02.09	clean and lubricate components
B-8.02.10	perform adjustments such as adding distilled water to battery
B-8.02.11	verify system operation

Sub-task

B-8.03 **Troubleshoots direct current (DC) systems.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

B-8.03.01	select and use diagnostic tools and equipment such as multimeters, scope meters, clamp-on ammeters and megohmmeters
B-8.03.02	perform sensory inspection on components for deterioration such as corrosion, loose torque and discolouration
B-8.03.03	isolate faults by de-energizing source of energy
B-8.03.04	de-energize system from all power sources
B-8.03.05	test system for zero potential using multimeter
B-8.03.06	identify presence of power anomalies such as ripple, noise and spikes
B-8.03.07	identify components that require repair or replacement
B-8.03.08	disassemble/reassemble components according to OEM specifications

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Sub-task

B-8.04 **Repairs direct current (DC) systems.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

B-8.04.01	select and use tools and equipment such as screwdrivers, wrenches and pliers
B-8.04.02	determine whether components require repair or replacement
B-8.04.03	select replacement components such as relays, brushes, batteries and fuses according to OEM specifications and code requirements
B-8.04.04	de-energize system from all power sources
B-8.04.05	disassemble/reassemble components according to OEM specifications
B-8.04.06	replace, adjust and modify components such as relays, brushes, batteries and fuses
B-8.04.07	test system for zero potential using multimeter
B-8.04.08	clean components before terminating to ensure good contact and continuity
B-8.04.09	verify operation of components

Task 9 Maintains grounding and bonding systems.

Context Grounding and bonding systems are used to complete a safe path for fault current. Their primary use is as a safeguard in the operation of electrical systems. Industrial electricians must be able to install, service and repair these systems in order to ensure their efficient operation and reduce unscheduled disruptions.

Required Knowledge

K 1	codes and regulations regarding the installation of grounding and bonding systems
K 2	methods of grounding
K 3	methods of bonding
K 4	system and component operation
K 5	components, controls, ratings and capabilities
K 6	OEM specifications for installation, inspection, troubleshooting, repair, replacement, modification and preventative maintenance
K 7	specifications, characteristics, types and sizes of components such as ground rods, ground grids and plates
K 8	electrical theory
K 9	events that lead to system failure
K 10	equipment performance history
K 11	potential hazards such as shocks and potential difference
K 12	safety procedures and equipment required for repair and service
K 13	methods and procedures for testing and verification of grounding and bonding systems and components

---

Sub-task

B-9.01 Installs grounding and bonding systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

B-9.01.01	determine size of ground and bond according to codes and regulations
B-9.01.02	select ground and bond method according to environmental conditions such as soil type, area and corrosive atmosphere

B-9.01.03 select and use tools and equipment such as wrenches, compression tools and exothermic welders

B-9.01.04 select and install ground components such as rods and plates according to code requirements

B-9.01.05 locate and secure ground and bond conductor using methods such as torquing, exothermic welding and anti-oxidation compounds according to code requirements

---

Sub-task

B-9.02 Services grounding and bonding systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

B-9.02.01 assess torque, cleanliness and corrosion of bonding terminations

B-9.02.02 ensure grounding and bonding terminations are secure

B-9.02.03 select and use tools and equipment such as torque wrenches, hammers and wire brushes

B-9.02.04 visually inspect components for wear, oxidation and loose connections

B-9.02.05 identify corroded, damaged or defective bonding components by discolouration and nicking

B-9.02.06 clean components to ensure good contact and lowest resistance

---

Sub-task

B-9.03 Troubleshoots grounding and bonding systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

B-9.03.01 select and use tools and equipment such as megohmmeters, multimeters, clamp-on ammeters and ohmmeters

B-9.03.02 perform continuity checks to determine if there is a break in grounding or bonding

B-9.03.03	perform sensory inspection for nicks, breaks, discolouration and loose connections
B-9.03.04	take voltage measurements to determine problems with ground and bond
B-9.03.05	check for current on the ground

Sub-task

B-9.04 Repairs grounding and bonding systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

B-9.04.01	select replacement components according to code requirements such as type, size, capacity and environment
B-9.04.02	select and use tools and equipment such as compression tools, exothermal welding equipment and torque wrenches
B-9.04.03	replace damaged conductors
B-9.04.04	clean conductors and metal surfaces before terminating to ensure good contact and continuity
B-9.04.05	locate and secure grounding and bonding components in appropriate locations to prevent further damage
B-9.04.06	verify fault has been corrected

Task 10 Maintains power generating systems.

Context Power generating systems such as solar cell, wind turbine and co-generation produce electricity to a variety of applications. Industrial electricians must be able to install, service and repair these systems in industrial plants in order to ensure their efficient operation and reduce unscheduled disruptions.

Required Knowledge

K 1	codes and regulations regarding the installation of power generating systems
K 2	types of power generating systems such as solar cell, photovoltaic, wind turbine and co-generation
K 3	components such as switchgear and transformers

K 4	hazards associated with power generating systems
K 5	methods and procedures for installing power generating systems
K 6	preventative and predictive maintenance schedules
K 7	inspection, maintenance, troubleshooting, repair, replacement and adjustment procedures and specifications
K 8	safety procedures and equipment required to access, inspect and service power generating systems
K 9	system and component operation
K 10	potential causes of power loss such as phase-to-phase shorts, overcurrent and under frequency
K 11	events that lead to system failure
K 12	history of equipment performance

Sub-task

B-10.01 Installs power generating systems. (NOT COMMON CORE)

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	no	yes	no	yes	yes	no	ND	ND	yes	ND	NV	ND

Key Competencies

B-10.01.01	select and use tools and equipment such as wrenches, knives and pliers
B-10.01.02	ensure proper egress around distribution system according to code requirements
B-10.01.03	ensure proper location and direction of component such as solar cell and wind turbine
B-10.01.04	perform phasing to achieve required rotation of three-phase rotating equipment
B-10.01.05	ensure cables are connected according to polarity and grounded as required
B-10.01.06	assemble and torque components in appropriate locations according to OEM specifications
B-10.01.07	terminate cable according to code and OEM specifications
B-10.01.08	follow installation procedures according to code and OEM specifications
B-10.01.09	verify system operation

Sub-task

B-10.02 Services power generating systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	no	yes	no	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

B-10.02.01	identify hazards of power generating system
B-10.02.02	isolate system from dynamic and kinetic energy
B-10.02.03	test system for zero potential using tools such as multimeters and high voltage testers
B-10.02.04	apply ground sets to phase conductors to drain capacitance charge
B-10.02.05	select tools and equipment such as pliers and torque wrenches
B-10.02.06	perform sensory inspection of components for deterioration such as corrosion, loose torque and discolouration
B-10.02.07	select and use diagnostic tools and equipment such as megohmmeters and thermal graphic cameras
B-10.02.08	identify worn, damaged, defective or hazardous components
B-10.02.09	identify components that require repair or replacement
B-10.02.10	clean and lubricate components
B-10.02.11	verify system operation

Sub-task

B-10.03 Troubleshoots power generating systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	no	yes	no	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

B-10.03.01	identify hazards of stored energy in capacitors, cabling and transformers
B-10.03.02	perform sensory inspection of components deterioration such as corrosion, corona, loose torque and discolouration
B-10.03.03	select and use diagnostic tools and equipment such as hi-pot testing tools, thermal graphic cameras and ultra-sonic detectors
B-10.03.04	isolate faults by de-energizing source of energy
B-10.03.05	test system for zero potential using high voltage tester and multimeter

B-10.03.06	apply ground sets to phase conductors to drain capacitance charge
B-10.03.07	identify worn, damaged, defective or hazardous components using methods such as oil samplings

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Sub-task

B-10.04 Repairs power generating systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	no	yes	no	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

B-10.04.01	identify hazards of stored energy in capacitors, cabling and transformers
B-10.04.02	determine whether components require repair or replacement
B-10.04.03	select and use tools and equipment such as torque wrenches, pliers and knives
B-10.04.04	select replacement components according to OEM specifications and code requirements
B-10.04.05	de-energize system from all power sources
B-10.04.06	test system for zero potential using high voltage tester and multimeter
B-10.04.07	apply ground sets to phase conductors to drain capacitance charge
B-10.04.08	disassemble/reassemble components according to OEM specifications
B-10.04.09	replace, adjust and modify components such as bushings and switches
B-10.04.10	clean components before terminating to ensure good contact and continuity
B-10.04.11	verify operation of components

BLOCK C ELECTRICAL EQUIPMENT

Trends	Lighting system load-shedding devices such as occupancy-detectors, task-lighting, automatic dimmers and building automation systems are increasingly being used to conserve electricity. Safety has driven advances in the design of electrical equipment such as tamper-proof receptacles and arc fault interrupters. Installation of electrical equipment and wiring must now include consideration of fire-stopping ratings in building design.
Related Components (including, but not limited to)	Electrical wiring, cabling and terminations. **Lighting systems**: light emitting diode (LED), high intensity discharge (HID), fluorescent lighting, compact fluorescent lamp (CFL), plasma, breakers, photocells, timers, conduits, cables, fasteners, cable trays and supports, contactors, transformers, switches. **Protection devices:** fuses, breakers, overloads, arc fault protection, ground-fault circuit interrupters (GFCIs), overcurrent devices, disconnects, switches, voltage regulators, synchronizers. **Rotating equipment**: AC and DC motors, generators, alternators, eddy current brakes/clutches, friction brakes/clutches, centrifugal switches, governors. **Drives and associated controls:** variable-frequency drives (VFDs), DC drives, soft-start, silicon-controlled rectifiers (SCRs). **Non-rotating equipment**: transformers, encoders, scales, start/stop stations, starters.
Tools and Equipment	See Appendix A.

Task 11 Maintains equipment, wiring, cabling and terminations.

Context Equipment, wiring, cabling and terminations are the electrical components linking the source to the load. This task also includes maintenance of seismic restraint systems, as required in certain geographic locations. Maintaining these components includes installation and repair.

Required Knowledge

K 1 regulations and code requirements regarding the installation of electrical wiring, cabling and terminations
K 2 types and functions of electrical wiring, cabling and terminations
K 3 capabilities and limitations of electrical wiring, cabling and terminations
K 4 installation procedures and techniques for electrical wiring, cabling and terminations
K 5 sizes of electrical wires and cables
K 6 termination procedures and considerations for dissimilar metals
K 7 types, functions, capabilities and limitations of raceways, cable trays, busways and associated components
K 8 bending and connecting techniques for conduit applications including rigid, electrical metallic tubing (EMT) and polyvinyl chloride (PVC)
K 9 installation procedures and techniques, and supporting and securing methods for raceways, cable trays, busways and associated components
K 10 jurisdictional regulations regarding seismic restraint systems
K 11 types of seismic restraint systems
K 12 risks of seismic events
K 13 equipment that contains seismic restraint systems such as battery banks, trays and control panels

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Sub-task

C-11.01 Installs electrical wiring, cabling and terminations.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	no	ND	ND	yes	ND	NV	ND

Key Competencies

C-11.01.01	install cable and conductors through raceways according to CEC and OEM specifications in order to prevent damage to cable and conductors and to separate power from control wiring to eliminate noise and induction
C-11.01.02	select and use lubricant as required by application
C-11.01.03	select and use tools and equipment such as rollers, wheels, tuggers, pulleys and sheaves
C-11.01.04	determine termination method to be used according to material and OEM specifications
C-11.01.05	prepare termination of conductors using methods such as cutting, crimping and torquing
C-11.01.06	terminate cables and conductors using methods such as nut and bolt, and compression connections
C-11.01.07	check for continuity and insulation of electrical wires and cables
C-11.01.08	label, verify and record installation of electrical wiring and cabling

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Sub-task

C-11.02 Installs raceways, cable trays, busways and associated components.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	no	ND	ND	yes	ND	NV	ND

Key Competencies

C-11.02.01	select and size raceways, cable trays, busways and associated components according to code, standards, environments and OEM specifications
C-11.02.02	lay out route of raceways, cable trays, busways and associated components according to code requirements such as number of bends allowed, and location and size of pull-box and fittings
C-11.02.03	perform mathematical calculations such as scaling, ratios and installation trigonometry

C-11.02.04	select and use hand and power tools such as torque wrenches, hammers, nut drivers and hack saws
C-11.02.05	select cable fittings such as rain-tight, dust-tight and explosion-proof fittings according to the installation environment
C-11.02.06	bend conduit and secure raceways according to code requirements

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Sub-task

C-11.03 Repairs electrical wiring, cabling and terminations.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

C-11.03.01	replace faulty electrical wiring and cabling
C-11.03.02	select and use tools and equipment such as thermal graphic cameras, megohmmeters and reflectometers to locate faults and verify repair
C-11.03.03	perform visual inspections to repair or replace worn or cracked coverings
C-11.03.04	repair conductor coverings and conductor using manufacturer-specific repair kit
C-11.03.05	replace, tighten and clean terminations to avoid overheating and to lower resistance
C-11.03.06	secure support systems, enclosures and adjacent equipment to avoid vibration of wires and terminations

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Sub-task

C-11.04 Maintains seismic restraint systems. (NOT COMMON CORE)

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	no	no	no	yes	no	yes	ND	ND	yes	ND	NV	ND

Key Competencies

C-11.04.01	select and use tools and equipment such as hand tools, torque wrenches and hydraulic wrenches
C-11.04.02	torque bolting according to periodic maintenance and after seismic events
C-11.04.03	inspect flexible joints, bolting and bracketing for any kind of damage, cracks or stresses according to periodic maintenance and after seismic events

C-11.04.04 coordinate non-destructive tests such as magnaflux and x-ray to check for cracks according to periodic maintenance

C-11.04.05 select mounting hardware according to seismic risk and engineering data

C-11.04.06 install mounting hardware according to local regulations and engineering data such as torque settings and size of bolting

C-11.04.07 repair and replace seismic hardware according to diagnostic from periodic maintenance and after seismic events

Task 12 Maintains lighting systems.

Context Various devices and fixtures are maintained by industrial electricians to meet the power and lighting requirements of the end users. Lighting systems are used to properly illuminate specified areas according to users' needs. DC powered lighting is used in limited applications such as emergency lighting. Maintaining lighting systems includes the installation of new components, upgrading of existing systems, servicing, troubleshooting and repairing.

Required Knowledge

K 1 codes and regulations regarding the installation of lighting systems

K 2 types of lighting systems such as LED, HID, CFL, fluorescent and incandescent

K 3 lighting system components and controls

K 4 component operation

K 5 installation, inspection, troubleshooting, repair and preventative maintenance procedures and techniques

K 6 lighting specifications

K 7 events that lead to system failure

K 8 history of equipment performance

K 9 DC lighting system for emergency lights

Sub-task

C-12.01 **Installs lighting systems.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	no	ND	ND	yes	ND	NV	ND

Key Competencies

C-12.01.01	select and use tools and equipment such as hand and power tools
C-12.01.02	select and inspect components required for installation according to building system, specifications and code requirements
C-12.01.03	identify support requirements for lighting systems according to OEM specifications
C-12.01.04	locate, mount and secure lighting components in locations specified by drawings, plans and code requirements
C-12.01.05	produce as-built drawings
C-12.01.06	assemble lighting components according to OEM specifications
C-12.01.07	verify operation of lighting system

Sub-task

C-12.02 **Services lighting systems.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

C-12.02.01	follow preventative maintenance schedule for changing lighting system components
C-12.02.02	clean lighting system components such as lenses and lens covers
C-12.02.03	recognize damage, faults or degradation of components in the lighting system such as leaking ballasts and burnt wiring
C-12.02.04	assess functionality of lighting systems and associated controls
C-12.02.05	dispose of lighting components such as fluorescents and ballasts according to environmental regulations
C-12.02.06	identify potential hazards such as dust build-up, fire hazards, heat and moisture

---

Sub-task

C-12.03 Troubleshoots lighting systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

C-12.03.01	select and use tools and equipment such as multimeters and hand tools
C-12.03.02	recognize worn, faulty and degraded components such as bulb flickers, tar leaks in ballast, bulb colour, and burnt or discoloured contacts and bulbs
C-12.03.03	determine viability of replacement or repair of components

---

Sub-task

C-12.04 Repairs lighting systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

C-12.04.01	select and use tools and equipment such as telescopic bulb removers/extractors, hand tools and multimeters
C-12.04.02	verify operating voltage according to fixture specifications
C-12.04.03	interpret wiring scheme to upgrade wiring of lighting system
C-12.04.04	select replacement components according to factors such as type, desired light colour, compatibility, size and capacity
C-12.04.05	replace components according to socket style and specifications
C-12.04.06	verify system operation

Task 13 Maintains protection devices.

Context	Protection devices include fuses, relays, overloads and over-current devices. They protect the equipment from fault damage and provide injury protection. Industrial electricians must be able to install, service, troubleshoot and repair these devices at various voltages.

Required Knowledge

K 1	codes and regulations regarding the installation of protection devices
K 2	types of protection devices such as fuses, relays, phase loss, solid state controls, surge protection, overloads and overcurrent devices
K 3	component characteristics such as ratings, controls and sizes
K 4	compatibility of components
K 5	installation, inspection, troubleshooting, maintenance and repair procedures and techniques
K 6	devices and component operation
K 7	potential hazards related to protection devices
K 8	probable causes of fault and appropriate corrective methods
K 9	events that lead to system failure
K 10	history of equipment performance
K 11	safety procedures required to repair protection devices

Sub-task

C-13.01 Installs protection devices.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	no	ND	ND	yes	ND	NV	ND

Key Competencies

C-13.01.01	determine type and model of protection device required according to service requirements such as voltage, current and torque
C-13.01.02	select and use tools and equipment such as hand and power tools
C-13.01.03	locate, mount and secure protection devices according to drawings, plans and code requirements
C-13.01.04	produce as-built drawings

C-13.01.05	assemble protection devices according to OEM specifications
C-13.01.06	commission protection devices with procedures such as verifying torque, voltage, start-up time and device settings

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Sub-task

C-13.02 Services protection devices.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

C-13.02.01	select and use tools and equipment such as thermal graphic cameras and hand tools
C-13.02.02	follow preventative maintenance schedule for checking resistance, gaps and mechanical action
C-13.02.03	simulate fault to test and calibrate protection devices
C-13.02.04	perform sensory inspection to identify damage and faults of protection devices, and conditions such as burnt smell, vibrations and discolouration
C-13.02.05	check torque of terminations
C-13.02.06	clean protection devices to remove dust, animals and moisture
C-13.02.07	verify settings of protection devices

Sub-task

C-13.03 Troubleshoots protection devices.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

C-13.03.01	select and use tools and equipment such as ammeters, megohmmeters, proximity testers, multimeters and fuse pullers
C-13.03.02	identify worn, faulty and degraded components such as burnt wires, hot breakers, malfunctioning components and loose breakers
C-13.03.03	simulate fault to test protection devices such as safety switches, GFCIs, fuses and breakers

Sub-task

C-13.04 Repairs protection devices.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

C-13.04.01	select and use tools and equipment such as hand tools and multimeters
C-13.04.02	perform resistance pre-test to ensure that replacement fuse is operational
C-13.04.03	select replacement components based on type, size, capacity and environment
C-13.04.04	determine whether components require repair or replacement
C-13.04.05	replace, adjust and modify components with procedures such as changing coils, dielectric oil and pitted contacts, and replacing fuse holders
C-13.04.06	verify device operation

Task 14 Maintains rotating equipment and associated controls.

Context Rotating equipment and associated controls transform electrical energy into mechanical energy (motors) or vice versa (generators) depending on application. These may include heating, ventilation, running a compressor, or manufacturing processes. Industrial electricians must be able to install, service, troubleshoot and repair these systems in order to ensure efficient operation and reduce unscheduled disruptions.

Required Knowledge

K 1	codes and regulations regarding the maintenance of rotating equipment and associated controls
K 2	types and operation of rotating equipment and associated controls
K 3	controls, ratings, capabilities and characteristics of components
K 4	installation, inspection, troubleshooting, maintenance and repair procedures and techniques
K 5	events that lead to system failure
K 6	history of equipment performance
K 7	potential hazards related to rotating equipment and associated controls
K 8	safety procedures required for service and repair

Sub-task

C-14.01 **Installs rotating equipment and associated controls.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

C-14.01.01	select and use tools and equipment such as hand and power tools
C-14.01.02	determine type and model of rotating equipment and controls required according to application
C-14.01.03	assemble and connect components such as resistance temperature detectors (RTDs), vibration probes and over temperature contacts according to OEM specifications
C-14.01.04	recognize hazards related to rotating equipment and associated controls
C-14.01.05	locate, mount and secure rotating equipment and associated controls according to OEM specifications and code requirements
C-14.01.06	commission rotating equipment and associated controls by checking connections, rotation direction, torque, voltage, and start-up and full-load current
C-14.01.07	ensure that safety features of equipment such as guards, controls and limits are operational
C-14.01.08	verify sequence of operations for equipment
C-14.01.09	produce as-built drawings

Sub-task

C-14.02 **Services rotating equipment and associated controls.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

C-14.02.01	select and use tools and equipment such as data monitors, thermal graphic cameras, air blowers and temperature guns
C-14.02.02	follow preventative maintenance schedule for checking brush length, seating and spring tension of brush holders
C-14.02.03	perform vibration analysis on rotating equipment in order to assess problems such as misalignment and worn bearings

C-14.02.04 identify damage and faults of rotating equipment and associated controls by observing conditions such as abnormal heat, discolouration, grooving and wear points

C-14.02.05 clean dust and carbon from rotating equipment and associated controls using air blower or non-conductive solution to prevent overheating and to ensure good contact

C-14.02.06 check wiring and cable connections, and torque of terminations

C-14.02.07 verify operation of components according to specifications

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Sub-task

C-14.03 Troubleshoots rotating equipment and associated controls.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

C-14.03.01 select and use tools and equipment such as hi-pot testers, vibration analyzers, ammeters, megohmmeters and multimeters

C-14.03.02 perform sensory inspection to identify abnormal heat, sounds, odours, vibrations and arcing/sparking sources

C-14.03.03 perform resistance checks on winding for phase loss

C-14.03.04 perform megohmmeter test to determine ground

C-14.03.05 identify worn, damaged or defective components such as bearings, slip rings and commutators

C-14.03.06 check seating, brush length and spring tension of brush holders

Sub-task

C-14.04 Repairs rotating equipment and associated controls.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

C-14.04.01	select and use tools and equipment such as bearing pullers, bearing heaters, spring tension gauges, commutator stones and feeler gauges
C-14.04.02	select replacement components based on type, size, capacity and environment
C-14.04.03	determine whether components require repair or replacement
C-14.04.04	replace components such as brush holders, springs, capacitors and bearings
C-14.04.05	perform equipment repairs such as recoating, and resurfacing brush ends and motor brake
C-14.04.06	run DC current through motor to remove moisture from windings and improve the ohmic value of the windings
C-14.04.07	verify system operation by performing load, hi-pot, neutral plane and dynamic rotation tests

Task 15 Maintains drives and associated controls.

Context Drives and associated controls provide speed, frequency, torque, current, time and braking control to motors. Industrial electricians must be able to install, service, troubleshoot and repair these systems in order to ensure efficient operation and reduce unscheduled disruptions.

Required Knowledge

K 1	codes and regulations regarding the maintenance of drives and associated controls according to OEM specifications
K 2	AC and DC theory
K 3	methods to prevent damage to drives from static electricity such as using static discharge wristbands and anti-static mats
K 4	processes related to drives and associated controls
K 5	types and operation of drives and associated controls
K 6	controls, ratings, capabilities and characteristics of components

K 7	installation, inspection, troubleshooting, maintenance and repair procedures and techniques
K 8	programming techniques and operating parameters of drives and associated controls
K 9	events that lead to system failure
K 10	history of equipment performance
K 11	potential hazards related to drives and associated controls
K 12	safety procedures required for service and repair

Sub-task

C-15.01 Installs drives and associated controls.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

C-15.01.01	select and use tools and equipment such as hand and power tools
C-15.01.02	determine type and model of drives and associated controls required according to application and motor
C-15.01.03	identify hazards related to drives and associated controls
C-15.01.04	locate, mount and secure drives and associated controls according to OEM specifications
C-15.01.05	program and configure drives and associated controls according to OEM specifications
C-15.01.06	verify device operation to confirm performance within parameters such as deceleration, loading and acceleration
C-15.01.07	produce as-built drawings

Sub-task

C-15.02 **Services drives and associated controls.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

C-15.02.01	select and use tools and equipment such as hand tools, data monitors, thermal graphic cameras, air blowers and temperature guns
C-15.02.02	follow preventative maintenance schedule for replacing filters, torquing lugs, backing up programs and checking fans
C-15.02.03	clean dust from drives and associated controls using air blower to prevent overheating
C-15.02.04	check wiring and cable connections, and torque of terminations

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Sub-task

C-15.03 **Troubleshoots drives and associated controls.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

C-15.03.01	read and interpret error codes by checking human machine interface (HMI) and referring to troubleshooting manual
C-15.03.02	verify for faults such as loose cables, low voltage and discolouration
C-15.03.03	identify problems with sequence of operation that affect the performance of the drive and motor
C-15.03.04	verify for required ground according to OEM specifications
C-15.03.05	identify communications problems
C-15.03.06	determine issues relating to the length of the conductors such as distance of motor from drive and the equal length of conductors for multiple motors

Sub-task

C-15.04 **Repairs drives and associated controls.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

C-15.04.01	replace faulty drives using hand tools
C-15.04.02	select and use tools and equipment such as multimeters, calibrators and signal generators
C-15.04.03	program cards using methods such as inserting integrated circuit (IC) with loaded program, copying from HMI and manually entering program
C-15.04.04	replace drive components such as back-up batteries, SCRs, cards and cooling fans
C-15.04.05	adjust control parameters such as speed, acceleration and overload settings
C-15.04.06	document changes to parameters
C-15.04.07	verify device operation

Task 16 Maintains non-rotating equipment and associated controls.

Context Non-rotating equipment includes transformers, welding equipment, heat tracing, electro-magnets, linear induction motors and their associated controls. Industrial electricians must install, service, troubleshoot and repair this equipment.

Required Knowledge

K 1	codes and regulations related to non-rotating equipment and associated controls
K 2	types, specifications and operation of non-rotating equipment and associated controls
K 3	controls, ratings, capabilities and characteristics of non-rotating equipment and associated controls
K 4	installation, inspection, troubleshooting, maintenance and repair procedures and techniques
K 5	events that lead to system failure
K 6	history of equipment performance

K 7	potential hazards related to non-rotating equipment and associated controls
K 8	safety procedures required for service and repair

Sub-task

C-16.01 **Installs non-rotating equipment and associated controls.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

C-16.01.01	select and use tools and equipment such as hand and power tools
C-16.01.02	determine type and model of non-rotating equipment and controls required according to application
C-16.01.03	assemble components according to OEM specifications
C-16.01.04	identify hazards related to non-rotating equipment and associated controls and discharge when required
C-16.01.05	locate, mount and secure non-rotating equipment and associated controls according to OEM specifications
C-16.01.06	commission non-rotating equipment and associated controls by checking connections, voltage, current and sequence of operations
C-16.01.07	produce as-built drawings

Sub-task

C-16.02 **Services non-rotating equipment and associated controls.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

C-16.02.01	select and use tools and equipment such as data monitors, thermal graphic cameras, air blowers and temperature guns
C-16.02.02	complete scheduled preventative maintenance tasks such as tightening loose connections and checking for excessive heat, discolouration and odours
C-16.02.03	identify damage and faults of non-rotating equipment and associated controls by observing conditions such as abnormal heat and discolouration

C-16.02.04	clean dust from non-rotating equipment and associated controls using air blower to prevent overheating
C-16.02.05	check wiring and cable connections, and torque of terminations
C-16.02.06	verify operation of components according to specifications

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Sub-task

C-16.03 Troubleshoots non-rotating equipment and associated controls.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

C-16.03.01	select and use tools and equipment such as hi-pot testers, ammeters, megohmmeters and multimeters
C-16.03.02	perform sensory inspection to identify abnormal heat, sounds and odours
C-16.03.03	monitor status of non-rotating equipment using phase status indicators
C-16.03.04	check voltage and current levels for each phase
C-16.03.05	perform megohmmeter test to check insulation integrity

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Sub-task

C-16.04 Repairs non-rotating equipment and associated controls.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

C-16.04.01	select and use tools and equipment such as multimeters and hand tools
C-16.04.02	select replacement components based on type, size, capacity and environment
C-16.04.03	determine whether components require repair or replacement
C-16.04.04	replace, adjust and modify equipment with procedures such as tightening loose connections and changing dielectric oil
C-16.04.05	verify system operation

BLOCK D EMERGENCY AND STANDBY SYSTEMS

Trends	Solar and wind systems are increasingly used to support emergency and standby systems. Therefore, industrial electricians require a high level of training on these systems. There is an increase in the use of PLCs and DCSs to simplify maintenance, operation and reliability of emergency and standby systems. This technological advance is going to continue to increase and will also require industrial electricians to develop the skills required to maintain these systems.
Related Components (including, but not limited to)	Batteries, inverters, solid state devices, heat sinks, circuit boards, cabling, capacitors, rectifiers, relays, transfer switches, prime movers, meters, bearings, brushes, slip rings.
Tools and Equipment	See Appendix A.

Task 17 Maintains uninterruptible power supply (UPS) systems.

Context UPS systems are used in industrial and institutional buildings to provide constant voltage for essential devices and to maintain power to critical equipment during power outages. They ensure seamless and bumpless transfer of power. Industrial electricians must be able to install, service, troubleshoot and repair UPS systems.

Required Knowledge

K 1	codes and regulations regarding the maintenance of UPS systems
K 2	types, sizes, ratings, capabilities and operation of UPS systems
K 3	installation, inspection, troubleshooting, repair and preventative maintenance procedures and techniques
K 4	components such as batteries, inverters, transfer switches, solid state devices, heat sinks and circuit boards
K 5	causes of component overheating such as dust, contamination, overloading and loose connections

K 6	inverter system fault indicators such as no output, alarms, odour, noise and breaker failure
K 7	battery faults such as low battery voltage, bulging cells, low electrolyte level, incorrect charging rate and failed solid-state devices
K 8	events that lead to system failure such as ambient high temperature and dirty ventilation filters
K 9	safety procedures for UPS systems
K 10	history of equipment performance
K 11	optimum performance of system and equipment
K 12	effects of static electricity on ICs
K 13	potential hazards of installation and repair such as battery acid, hydrogen discharge and stored electrical energy
K 14	compatibility of solvents with UPS components

Sub-task

D-17.01 Installs uninterruptible power supply (UPS) systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

D-17.01.01	select and use tools and equipment such as compression tools, torque wrenches, hand tools, isolated tools, power tools, knock-out cutters, hole saws, thermal graphic cameras and multimeters
D-17.01.02	determine location and installation procedure of components by reading and interpreting prints, OEM manuals and code requirements
D-17.01.03	select interconnection electrical fittings according to engineered drawings and building codes
D-17.01.04	visually inspect equipment to be installed to check for damage and to ensure name plate data matches engineered drawings
D-17.01.05	assemble system components according to OEM specifications and engineered drawings
D-17.01.06	connect system components such as cables, batteries, inverters, alarms and solar panels according to code requirements
D-17.01.07	terminate and torque all connections according to OEM specifications and code requirements
D-17.01.08	check and fill non maintenance-free batteries with electrolyte

D-17.01.09	commission UPS system to ensure correct voltages, frequency and operation of charging system, transfer switch, alarms, isolating breakers, and HVAC system
D-17.01.10	produce as-built drawings

Sub-task

D-17.02 Services uninterruptible power supply (UPS) systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

D-17.02.01	select and use tools and equipment such as frequency meters, multimeters, thermal graphic cameras, hydrometers and torque wrenches
D-17.02.02	check and correct electrolyte levels according to OEM specifications
D-17.02.03	check all battery connection torques according to OEM specifications
D-17.02.04	check and set system voltages such as float voltage and inverter output voltage according to OEM specifications
D-17.02.05	record individual cell voltages, SG and temperatures, and compare to OEM specifications
D-17.02.06	check and set charging current limit according to OEM specifications
D-17.02.07	change HVAC and inverter filters according to OEM specifications
D-17.02.08	check and set inverter output frequency according to local conditions and OEM specifications
D-17.02.09	test alarms according to engineered drawings
D-17.02.10	check ambient temperature according to engineered drawings and OEM specifications
D-17.02.11	test transfer switch to ensure seamless and bumpless transfer according to OEM specifications
D-17.02.12	perform battery load test to check discharge time according to OEM specifications
D-17.02.13	identify calendar life of batteries to replace according to OEM specifications
D-17.02.14	verify system operation

Sub-task

D-17.03 **Troubleshoots uninterruptible power supply (UPS) systems.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

D-17.03.01	select and use test equipment such as clamp-on ammeters, multimeters, thermal graphic cameras and hydrometers
D-17.03.02	perform sensory inspection to verify ambient temperature, equipment damage, and presence of smoke or unusual sounds and odours
D-17.03.03	measure input/output (I/O) voltages and frequency
D-17.03.04	check if breakers are opened, closed or tripped
D-17.03.05	verify panel meters are operational
D-17.03.06	close breakers in sequence to verify system operation
D-17.03.07	compare and interpret previous historical data with data from troubleshooting
D-17.03.08	identify faulty components such as rectifiers, capacitors, batteries and SCRs

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Sub-task

D-17.04 **Repairs uninterruptible power supply (UPS) systems.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

D-17.04.01	select and use tools and equipment such as multimeters, frequency meters, hydrometers, scope meters, thermal graphic cameras, torque wrenches and hand tools
D-17.04.02	select and verify replacement component according to OEM specifications
D-17.04.03	isolate and de-energize faulty component to allow safe access
D-17.04.04	remove load from battery bank before removing faulty cell or inverter
D-17.04.05	discharge capacitors to allow safe access to component
D-17.04.06	replace and clean faulty component according to industry practices
D-17.04.07	replace cold solder connections using soldering iron
D-17.04.08	power up system sequentially to verify its proper operation

D-17.04.09	measure and set voltages and frequency to ensure battery is charging correctly and inverter output is correct
D-17.04.10	perform battery load test to check discharge time according to OEM specifications

Task 18 Maintains standby power generating systems.

Context Standby power generating systems provide an alternate source of energy for power outages, energy management and safe plant shutdowns. These systems may also be used to supplement utility power. Industrial electricians must be able to safely install, service, troubleshoot and repair these systems to ensure they are ready for use.

Required Knowledge

K 1	codes and regulations regarding the maintenance of standby power generating systems such as for grounding and bonding
K 2	types, sizes, ratings and capabilities of alternate standby power generating systems such as diesel, natural gas, solar and wind
K 3	components such as generators, exciters and regulators
K 4	types of generators such as single- and three-phase
K 5	inspection, servicing, troubleshooting, repair and commissioning procedures and techniques
K 6	load requirements such as voltage, phase and kilovolt-ampere (kVA)
K 7	automatic and manual change-over systems
K 8	electrical protection for generators
K 9	environmental issues such as fuel containment, exhaust and noise
K 10	hazards in installing standby power generating systems
K 11	components requiring inspection such as belts, louvers and filters
K 12	system fault indicators such as no output and alarms
K 13	events that lead to system failure
K 14	history of equipment performance
K 15	hazards of repair such as battery acid, stored energy in battery, rotating equipment and accidental start-up of system
K 16	control parameters such as speed and synchronization

Sub-task

D-18.01 Installs standby power generating systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

D-18.01.01	select and use tools and equipment such as compression tools, torque wrenches, hand tools, insulated tools, phase meters, power tools, knock-out cutters, hole saws, hoisting and rigging equipment, thermal graphic cameras and multimeters
D-18.01.02	determine location and installation procedure of components by reading and interpreting prints, OEM manuals and code requirements
D-18.01.03	select interconnection electrical fittings according to engineered drawings and building codes
D-18.01.04	visually inspect equipment to be installed to check for damage and to ensure name plate data matches engineered drawings
D-18.01.05	assemble system components according to OEM specifications and engineered drawings
D-18.01.06	connect system components such as cables, batteries and alarms according to code requirements
D-18.01.07	terminate and torque all connections according to OEM specifications and code requirements
D-18.01.08	check electrolyte level and SG of non maintenance-free batteries
D-18.01.09	verify phasing matches utility power
D-18.01.10	commission standby power generating system to ensure correct voltages, frequency and operation of transfer switch, alarms, isolating breakers and ventilation system
D-18.01.11	produce as-built drawings

Sub-task

D-18.02 Services standby power generating systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

D-18.02.01	select and use tools and equipment such as frequency meters, multimeters, scope meters, thermal graphic cameras, hydrometers, pressure gauges, pneumatic tools, hand tools, and torque and impact wrenches
D-18.02.02	check and correct electrolyte levels and SG on starting system according to OEM specifications
D-18.02.03	inspect battery charging system on starting system to ensure proper current rate
D-18.02.04	check fuel levels, fluid levels and SG of coolant, and change according to maintenance schedule
D-18.02.05	clean and lubricate components
D-18.02.06	change filters such as air, fuel and oil according to OEM specifications
D-18.02.07	perform sensory inspection to recognize abnormal heat, sounds, odours, vibrations and arcing sources, and worn, damaged or defective components such as bearings, brushes and slip rings
D-18.02.08	ensure guards are in place
D-18.02.09	check wiring and cable connections
D-18.02.10	check and set genset output voltage and frequency according to OEM specifications
D-18.02.11	test alarms according to engineered drawings
D-18.02.12	check ambient temperature according to engineered drawings and OEM specifications
D-18.02.13	test transfer switch to ensure transfer according to OEM specifications
D-18.02.14	verify system operation
D-18.02.15	perform generator run test according to OEM specifications

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Sub-task

D-18.03 Troubleshoots standby power generating systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

D-18.03.01	select and use test equipment such as frequency meters, multimeters, thermal graphic cameras and hydrometers
D-18.03.02	perform sensory inspection to verify ambient temperature, equipment damage, and presence of smoke or unusual sounds and odours
D-18.03.03	review and analyze sequence of events that led to the problem such as alarm and fault history, and trends
D-18.03.04	measure output voltage and frequency to ensure correct operation
D-18.03.05	check if breakers are opened, closed or tripped
D-18.03.06	verify panel meters are operational
D-18.03.07	compare and interpret previous historical data with data from troubleshooting
D-18.03.08	identify faulty components such as batteries, voltage regulators, exciters, brushes, ignition systems, governors and switchgear
D-18.03.09	identify faults such as short circuit, excessive loads and loose connections
D-18.03.10	perform transfer function and load tests according to OEM and site specifications
D-18.03.11	test starting system according to OEM and site specifications

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Sub-task

D-18.04 Repairs standby power generating systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

D-18.04.01	select and use tools and equipment such as multimeters, frequency meters, hydrometers, scope meters, phase meters, thermal graphic cameras, torque wrenches and hand tools
D-18.04.02	select and verify replacement component according to OEM specifications

D-18.04.03 isolate and lock-out standby system to allow access and replacement of component

D-18.04.04 replace and clean faulty component according to industry practices

D-18.04.05 replace cold solder connections using soldering iron

D-18.04.06 measure and set voltages and frequency according to OEM and site specifications

D-18.04.07 verify phasing matches utility power before standby system goes online

D-18.04.08 verify starting system after battery replacement according to OEM and site specifications

D-18.04.09 perform battery load test to check discharge time according to OEM specifications

D-18.04.10 power up system sequentially to verify its proper operation

BLOCK E COMMUNICATION SYSTEMS

Trends	There is a greater use of Internet-based interfaces for communication systems. There is a trend towards more wireless alarm, network communication and video communication.
Related Components (including, but not limited to)	**Alarm systems:** Fire alarms, gas detectors, pull station, smoke detectors, floats, pressure sensors, limit switches, fasteners, cameras, speakers, heat detectors, infrared sensors, motion sensors, bells, whistles, annunciators, tamper switches, end of line (EOL) resistors, duct detectors **Paging systems:** amplifiers, speakers, microphones, music system, **Multimedia systems:** cameras, monitors, microphones, screens, projectors, power supplies. **Network systems:** computers, monitors, switches, routers, printers, hard drives, foil, balluns, antennae, jacks, cabinets, patch panels, modules, conduits, boxes.
Tools and Equipment	See Appendix A.

Task 19 Maintains alarm systems.

Context Alarm systems are installed to provide timely warnings to aid in the safety of personnel, environment and facilities. They also notify authorities and control equipment in emergency situations. They need to be maintained to the highest standards to ensure functionality.

Required Knowledge

K 1	codes and regulations regarding the installation, inspection, troubleshooting, repair and servicing of alarm systems
K 2	broad-based and manufacturer-specific training requirements for alarm systems
K 3	types of alarm systems such as fire, heat, security and gas
K 4	alarm system components, controls, parameters capabilities and characteristics

K 5	specifications for installation, maintenance, inspection, repair and troubleshooting
K 6	events that lead to system failure
K 7	history of equipment performance
K 8	authorities having jurisdiction for various alarm systems such as fire and gas

---

Sub-task

E-19.01 Installs alarm systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	no	ND	ND	yes	ND	NV	ND

Key Competencies

E-19.01.01	select and use tools and equipment such as hand tools, multimeters and battery testers
E-19.01.02	assemble alarm system components such as detectors, indicating devices and annunciators according to OEM specifications
E-19.01.03	locate and mount components in appropriate locations according to drawings and specifications
E-19.01.04	configure circuitry and panel for alarm systems such as addressable and conventional
E-19.01.05	connect alarm systems to communication systems for notification of authorities such as security companies and fire departments
E-19.01.06	test and verify alarm system in order to comply with code requirements
E-19.01.07	record and sign off panel and wiring documentation
E-19.01.08	ensure record of floor plan matches the information in the panel

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Sub-task

E-19.02 Services alarm systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	no	ND	ND	yes	ND	NV	ND

Key Competencies

E-19.02.01	select and use tools and equipment such as hand tools, smoke cans, pull stations and portable heating elements
E-19.02.02	clean alarm system components of dust to ensure accurate operation
E-19.02.03	check that parameters such as timing, EOL resistor and calibration are operating according to OEM specifications
E-19.02.04	select replacement components based on type, compatibility, size, environment and capacity
E-19.02.05	replace components according to manufacturer-specified life cycle and legislated requirements
E-19.02.06	recognize worn, damaged or defective components
E-19.02.07	check wiring and cable connections to ensure good continuity
E-19.02.08	verify system's operational requirements such as audibility, visual alarms and connections with sprinkler system
E-19.02.09	document faults and test data

Sub-task

E-19.03 Troubleshoots alarm systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	no	ND	ND	yes	ND	NV	ND

Key Competencies

E-19.03.01	select and use tools and equipment such as hand tools, multimeters and smoke cans
E-19.03.02	isolate faults in alarm systems by referring to panels
E-19.03.03	determine zone, type and status of alarm such as "trouble" and "alarm"
E-19.03.04	perform sensory inspection to identify presence of conditions such as smoke, corrosion and water damage
E-19.03.05	perform and interpret diagnostic tests such as internal diagnostics, battery tests, power supply tests and resistance tests

Sub-task

E-19.04 **Repairs alarm systems.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	no	ND	ND	yes	ND	NV	ND

Key Competencies

E-19.04.01	select and use tools and equipment such as hand tools, magnets and multimeters
E-19.04.02	select replacement components based on characteristics such as type, size, environment and capacity
E-19.04.03	replace faulty components such as batteries, power supplies, sensors, remote displays and pull stations
E-19.04.04	re-mount components in previous locations
E-19.04.05	adjust locations for alarm systems according to code regulations and operational requirements
E-19.04.06	re-verify fire alarm system operation
E-19.04.07	verify alarm system operation
E-19.04.08	document repairs performed

Task 20 Maintains paging systems.

Context Paging systems allow for communication between various locations throughout the facility. Industrial electricians install, service, inspect, troubleshoot and repair these systems in order to ensure security, safety and production.

Required Knowledge

K 1	codes and regulations regarding the installation, inspection, troubleshooting, servicing and repair of paging systems
K 2	types of paging systems such as public address systems, duress (panic) alarms and intercom systems
K 3	specifications for installation, maintenance, inspection, troubleshooting and repair
K 4	installation, maintenance, inspection, troubleshooting and repair procedures
K 5	paging system components, controls, parameters, operation and capabilities

K 6	events that lead to system failure
K 7	history of equipment performance

Sub-task

E-20.01 **Installs paging systems.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	no	ND	ND	yes	ND	NV	ND

Key Competencies

E-20.01.01	select and use tools and equipment such as hand tools and multimeters
E-20.01.02	determine wiring types and methods according to specifications and code
E-20.01.03	assemble paging system components such as amplifiers and annunciation equipment according to OEM specifications
E-20.01.04	locate and mount components in appropriate locations according to drawings and specifications
E-20.01.05	configure circuitry and panel for paging systems
E-20.01.06	balance impedance for speakers
E-20.01.07	connect paging system to UPS
E-20.01.08	test and verify paging system in order to comply with code requirements

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Sub-task

E-20.02 **Services paging systems.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

E-20.02.01	select and use tools and equipment such as decibel (dB) meters, multimeters and hand tools
E-20.02.02	ensure that paging system is heard in all required areas
E-20.02.03	select replacement components based on type, compatibility, size, environment and capacity
E-20.02.04	replace components according to OEM specifications

E-20.02.05 check wiring connections to ensure good continuity

E-20.02.06 document faults and test data

Sub-task

E-20.03 Troubleshoots paging systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

E-20.03.01 isolate faults in paging systems by testing system performance and functionality

E-20.03.02 check voltage, wattage, power supply and wiring connections to ensure good continuity

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Sub-task

E-20.04 Repairs paging systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

E-20.04.01 select and use tools and equipment such as hand tools and multimeters

E-20.04.02 select replacement components based on characteristics such as type, size, environment and capacity

E-20.04.03 replace faulty components such as speakers, microphones and amplifiers

E-20.04.04 adjust locations for paging systems according to code requirements

E-20.04.05 verify system operation

E-20.04.06 document repairs performed

Task 21 Maintains multimedia systems. (NOT COMMON CORE)

Context	Multimedia systems are used to transmit audio and video information. These systems can be used mainly for administrative purposes (orientation, meetings and safety). They need to be maintained on a regular basis by industrial electricians to ensure their function and reliability.

Required Knowledge

K 1	codes and regulations regarding the installation, servicing and repair of multimedia systems
K 2	types of multimedia systems such as analog and digital
K 3	components such as speakers, receivers, screens, projectors, monitors, computers and cameras
K 4	component operation
K 5	installation, maintenance, inspection, troubleshooting and repair procedures and techniques
K 6	types of cables such as fibre optic, coaxial, category 5 (CAT-5), and shielded and unshielded cables
K 7	multimedia system controls and parameters
K 8	events that lead to system failure
K 9	history of equipment performance

Sub-task

E-21.01 Installs multimedia systems. (NOT COMMON CORE)

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	no	no	no	yes	yes	no	ND	ND	yes	ND	NV	ND

Key Competencies

E-21.01.01	select and use tools and equipment such as hand tools, signal injectors, colour bar generators and multimeters
E-21.01.02	determine wiring types and methods according to specifications and codes
E-21.01.03	locate and mount components such as speakers, receivers, monitors and screens in appropriate locations according to drawings and specifications
E-21.01.04	configure circuitry for multimedia systems
E-21.01.05	test and verify multimedia system

Sub-task

E-21.02 Services multimedia systems. (NOT COMMON CORE)

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	no	no	no	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

E-21.02.01	select and use tools and equipment such as multimeters, analyzers and hand tools
E-21.02.02	ensure that multimedia system is heard and seen in all required areas
E-21.02.03	select replacement components based on type, compatibility, size, environment and capacity
E-21.02.04	replace components according to OEM specifications
E-21.02.05	check wiring connections to ensure good continuity
E-21.02.06	document faults and test data

Sub-task

E-21.03 Troubleshoots multimedia systems. (NOT COMMON CORE)

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	no	no	no	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

E-21.03.01	select and use tools and equipment such as colour bar generators, signal injectors and oscilloscopes
E-21.03.02	isolate faults in multimedia systems using procedures such as disconnecting power, replacing cables and interchanging components
E-21.03.03	test system performance and functionality
E-21.03.04	check power supply and wiring connections to ensure good continuity

Sub-task

E-21.04 **Repairs multimedia systems. (NOT COMMON CORE)**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	no	no	no	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

E-21.04.01	select and use tools and equipment such as hand tools and multimeters
E-21.04.02	select replacement components based on characteristics such as type, size, environment and capacity
E-21.04.03	replace faulty components such as lamps and cables
E-21.04.04	adjust locations for multimedia systems
E-21.04.05	verify system operation
E-21.04.06	document repairs performed

Task 22 Maintains network systems.

Context Network systems are designed to manage voice, video and data through optical and copper cabling as well as wireless data transfer. Applications of network systems include process control and telecommunications. To minimize down time, these systems need to be maintained by industrial electricians.

Required Knowledge

K 1	codes and regulations regarding the maintenance of network systems
K 2	types of network systems such as Ethernet, peer to peer and wireless
K 3	types of network cabling such as fibre optic and copper
K 4	telecommunication industry standards for fibre optic cables
K 5	installation considerations for fibre optic networks such as terminations, location, pulling forces, lubricants and turning radius
K 6	components such as modems, routers and switches, and their operation
K 7	installation, maintenance, inspection, troubleshooting and repair procedures and techniques according to engineered drawings and industry standard practices
K 8	network system controls, parameters and capabilities

K 9	events that lead to system failure
K 10	history of equipment performance

Sub-task

E-22.01 **Installs network systems.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	no	ND	ND	yes	ND	NV	ND

Key Competencies

E-22.01.01	select and use tools and equipment such as tension gauges, pulling eyes, multimeters, optical meters and punch-down tools
E-22.01.02	select and use lubricants according to OEM specifications
E-22.01.03	determine wiring types and methods according to specifications and codes
E-22.01.04	locate, mount and fasten network system components such as racks, cabinets and termination devices in appropriate locations according to drawings and specifications
E-22.01.05	test and verify network system

Sub-task

E-22.02 **Services network systems.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	no	ND	ND	yes	ND	NV	ND

Key Competencies

E-22.02.01	select and use tools and equipment such as multimeters, analyzers, punch-down tools and hand tools
E-22.02.02	select replacement components based on type, compatibility, size, environment and capacity
E-22.02.03	replace components according to OEM specifications
E-22.02.04	check wiring and fibre optic terminations using analyzers
E-22.02.05	clean dust from network system components to ensure accurate operation
E-22.02.06	perform visual check of components for faults such as supports too tight and kinks in cable

Sub-task

E-22.03 **Troubleshoots network systems.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	no	ND	ND	yes	ND	NV	ND

Key Competencies

E-22.03.01	select and use tools and equipment such as analyzers for copper and fibre optic cables, punch-down tools and hand tools
E-22.03.02	determine distance and connection integrity using analyzers
E-22.03.03	perform integrity check of components for faults such as supports too tight, and kinks and nicks in cable
E-22.03.04	check terminations and connectors according to industry standards
E-22.03.05	check interconnections for loose or disconnected cable
E-22.03.06	verify components communicate with each other

Sub-task

E-22.04 **Repairs network systems.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	no	ND	ND	yes	ND	NV	ND

Key Competencies

E-22.04.01	select and use tools and equipment such as hand tools, analyzers and multimeters
E-22.04.02	select replacement components such as switches, routers and transceivers based on characteristics such as type, size, environment and capacity
E-22.04.03	replace faulty components such as cables and interconnect cables
E-22.04.04	document repairs performed

BLOCK F PROCESS CONTROL SYSTEMS

Trends

There is an increased use of wireless systems, internetworking protocol (IP) and addressable components for field devices that are used as nodes which communicate to the central processing unit (CPU). The effect is reduced cost, and installation and repair time. Industrial electricians are now required to do more configuration and programming.

Another trend in this trade is an increased responsibility for managing process control systems.

Related Components (including, but not limited to)

I/O devices: transducers, transmitters, indicator lights, timers, converters, photocells, valves, potentiometers, controllers, actuators, solenoids, push buttons, horns, buzzers, meters, switches (proximity, selector, limit).

Control systems: DCSs, PLCs, screens, racks, cards, modules (communication, history and process management), cabling, computers, keyboards, monitors, mouse, HMI.

Tools and Equipment

See Appendix A.

Task 23 Maintains input/output (I/O) field devices.

Context

I/O field devices are used in control systems. There may be analog or digital (discrete) field devices. Industrial electricians must be able to install, service, troubleshoot and repair these devices.

Required Knowledge

K 1	codes and regulations regarding the installation of I/O field devices
K 2	types, size, rating and functions of input field devices such as transducers, limit switches and stop switches
K 3	types, size, rating and functions of output field devices such as indicator lights, solenoids and control valves
K 4	compatibility of devices with PLCs or DCSs
K 5	installation environment
K 6	operation of I/O field devices

K 7	installation, inspection, troubleshooting, servicing and repair procedures and techniques
K 8	events that lead to system failure
K 9	history of equipment performance
K 10	compatibility of replacement components
K 11	types of connectors, cabling and shielding
K 12	types of lubricants and anti-corrosion compounds
K 13	communication protocols
K 14	ladder and logic diagrams
K 15	networking
K 16	types of converters such as current to pressure (I/P) and temperature to pressure (T/P)

Sub-task

F-23.01 Installs input/output (I/O) field devices.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

F-23.01.01	select and use tools and equipment such as multimeters, calibrators, hand tools, personal computers and communication/configuration devices
F-23.01.02	visually inspect equipment to be installed to check for damage and to ensure name plate data matches engineered drawings
F-23.01.03	locate analog and digital I/O devices by reading and interpreting prints, OEM manuals and codes
F-23.01.04	connect grounding, shielding, piping and wiring according to OEM and site specifications, and codes
F-23.01.05	align sensors, transmitters and receivers according to OEM specifications
F-23.01.06	ensure polarity of wiring to field devices
F-23.01.07	program and configure device by setting protocol and mapping PLCs according to OEM specifications and engineered drawings
F-23.01.08	ensure calibration data for external devices matches those pre-programmed in the PLCs
F-23.01.09	calibrate analog field device according to engineered drawings

F-23.01.10 commission analog and digital devices, and modify the settings according to engineered drawings and site specifications

F-23.01.11 produce as-built drawings

Sub-task

F-23.02 Services input/output (I/O) field devices.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

F-23.02.01 select and use tools and equipment such as multimeters, protocol communicators, calibrators and network analyzers

F-23.02.02 detect I/O field device defects such as corrosion, loose wiring and cabling, mechanical damage and wear

F-23.02.03 perform sensory inspection of components such as limit switches, photocells and transmitters for damage, wear or misalignment

F-23.02.04 review and analyze trends from input device signal for a specified time period to verify integrity of signal

F-23.02.05 check network protocols to verify proper network communication

F-23.02.06 check and set power supply voltages

F-23.02.07 change wireless output device battery according to OEM specifications

F-23.02.08 calibrate analog input devices (temperature, speed, flow and pressure) according to engineered drawings, and OEM and site specifications, and record as found and as left

F-23.02.09 calibrate analog output devices (current, millivolts, volts and resistance) according to engineered drawings, and OEM and site specifications, and record as found and as left

F-23.02.10 perform I/O (on/off) test on discrete device

F-23.02.11 verify operation of I/O field devices following service

Sub-task

F-23.03 Troubleshoots input/output (I/O) field devices.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

F-23.03.01	select and use tools and equipment such as multimeters, protocol communicators, calibrators and network analyzers
F-23.03.02	perform sensory inspection to check for ambient temperature, abnormal heat, equipment damage, and presence of corrosion, smoke or unusual odours
F-23.03.03	verify presence of device and wire continuity according to engineered drawings
F-23.03.04	measure voltage, current, distance, gaps and alignment of I/O field devices according to engineered drawings
F-23.03.05	perform calibration test on analog device to verify signal
F-23.03.06	ensure calibration data for external devices matches those pre-programmed in the PLCs
F-23.03.07	perform I/O (on/off) test on discrete device to verify operation
F-23.03.08	apply Force to output device from PLC or DCS to verify operation and remove Force upon completion
F-23.03.09	review and analyze signal trends to or from field device
F-23.03.10	isolate I/O devices to aid in determining the fault
F-23.03.11	put the loop in Manual mode to prevent process upset and put back to Automatic mode upon completion
F-23.03.12	view the PLC and DCS program or the alert while process is running to determine the I/O fault

Sub-task

F-23.04 **Repairs input/output (I/O) field devices.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

F-23.04.01	select and use tools and equipment such as multimeters, protocol communicators, calibrators and network analyzers
F-23.04.02	select and verify replacement component according to OEM specifications and engineered drawings
F-23.04.03	replace faulty wiring and check for continuity according to local regulations and site specifications
F-23.04.04	apply Force to output device from PLC or DCS to bypass alarms and shutdowns while doing the replacement, and take Force out upon completion
F-23.04.05	put the loop in Manual mode to prevent process upset, and bypass alarms and shutdowns while doing the replacement and put back to Automatic mode upon completion
F-23.04.06	isolate power and process to the device prior to replacement
F-23.04.07	clean and realign sensor to ensure proper operation of field devices
F-23.04.08	replace field device according to OEM specifications and engineered drawings
F-23.04.09	program and configure device by setting protocol according to OEM specifications and engineered drawings
F-23.04.10	calibrate analog input devices (temperature, speed, flow and pressure) according to engineered drawings, and OEM and site specifications, and record as found and as left
F-23.04.11	calibrate analog output devices (current, millivolts, volts and resistance) according to engineered drawings, and OEM and site specifications, and record as found and as left
F-23.04.12	perform I/O (on/off) test on discrete device after repair or replacement
F-23.04.13	verify operation of replaced, aligned, adjusted and calibrated devices

Task 24 Maintains control systems.

Context Control systems are used to efficiently operate processes and assembly operations. These systems are controlled by computer and may be made up of DCSs and PLCs. They allow flexibility in the reconfiguration of process variables. The maintenance of control systems implies installation, servicing, troubleshooting, repair and optimization of PLCs and DCSs.

Required Knowledge

K 1	codes and regulations regarding the maintenance of control systems
K 2	types and functions of control systems and components such as monitors, CPUs and I/O racks
K 3	power supply criteria such as type, size and rating
K 4	maintenance, installation, inspection, troubleshooting and repair procedures and techniques
K 5	interference such as harmonics and electromagnetic interference (EMI), and effects of static electricity on system components
K 6	grounding and bonding according to OEM specifications and local regulations
K 7	types of output relays such as solid-state and mechanical
K 8	types of hardware used for constructing control systems such as rail devices and wire channels
K 9	industrial process operation and requirements
K 10	causes of faults such as overloaded power supply, faulty communication card and board failure
K 11	events that lead to system failure
K 12	history of equipment performance
K 13	software program, and upgrade and back-up procedures
K 14	OEM system capabilities such as replacement of components when system is energized
K 15	types of PLCs
K 16	PLC capabilities such as on-line and off-line programming
K 17	capabilities, limitations and performance parameters of systems and components
K 18	types of cards such as analog I/O, and digital I/O
K 19	software and hardware modification procedures
K 20	HMI usage, editing, interpretation and modifications

Sub-task

F-24.01 **Installs control systems.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

F-24.01.01	select and use tools and equipment such as multimeters, hand tools, and torque and specialty wrenches
F-24.01.02	visually inspect equipment to be installed to check for damage and to ensure name plate data matches engineered drawings
F-24.01.03	locate and mount components such as power supplies, racks and CPUs by reading and interpreting prints, OEM manuals and code requirements
F-24.01.04	connect grounding, shielding and wiring according to OEM and site specifications, and code requirements
F-24.01.05	ensure polarity of wiring to control system components
F-24.01.06	power up the system sequentially to ensure proper functionality of all system blocks
F-24.01.07	configure CPU by setting protocol according to OEM specifications and engineered drawings
F-24.01.08	ensure control systems/HMI access is enabled via remote Web access
F-24.01.09	ensure correct communication to all the system blocks such as HMI, IP devices, analog blocks and I/O blocks
F-24.01.10	upload and execute system program according to OEM and engineering specifications, and system application
F-24.01.11	test field devices to ensure they report properly to CPU and have correct range values
F-24.01.12	commission control system, and modify the settings if required, according to process requirements, engineered drawings and site specifications
F-24.01.13	produce as-built drawings and back-up program according to site specifications

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Sub-task

F-24.02 Services control systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

F-24.02.01	select and use tools and equipment such as hand tools and multimeters
F-24.02.02	perform sensory inspection of components for loose wiring and cabling, burn marks, stains, excessive heat, odours, unusual noises, evidence of rodents and water damage
F-24.02.03	check, set and record power supply voltages
F-24.02.04	tighten all terminations according to OEM specifications
F-24.02.05	change panel filters and clean components
F-24.02.06	change CPU battery
F-24.02.07	back up program before and after installation of updates
F-24.02.08	install program updates and ensure proper operation of system afterwards
F-24.02.09	monitor fault lights and alarms

Sub-task

F-24.03 Troubleshoots control systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

F-24.03.01	select and use tools and equipment such as hand tools and multimeters
F-24.03.02	perform sensory inspection of components for loose wiring and cabling, burn marks, stains, excessive heat, odours, unusual noises, evidence of rodents and water damage
F-24.03.03	verify power supply voltages and current according to engineering specifications
F-24.03.04	monitor fault lights and alarms
F-24.03.05	inspect for tripped breakers and blown fuses
F-24.03.06	check for communication errors between individual components

F-24.03.07 put the loop in Manual mode to prevent process upset and to aid in determining the fault, and put back to Automatic mode upon completion

F-24.03.08 verify readings of analog input devices at the HMI according to engineering specifications

F-24.03.09 produce analog outputs from control system to test output loop

F-24.03.10 perform I/O (on/off) test on each digital I/O sequentially

F-24.03.11 apply Force to I/O to verify operation of control system and remove Force upon completion

F-24.03.12 bypass alarms and shutdowns while performing the troubleshooting and remove upon completion

F-24.03.13 review and analyze signal trends to or from field device to aid in determining the fault

F-24.03.14 isolate I/O devices to aid in determining the fault

F-24.03.15 view PLC and DCS program or alert while process is running to determine the I/O fault

F-24.03.16 verify software versions to determine if update is required

F-24.03.17 view programming logic online to identify possible errors

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Sub-task

F-24.04 Repairs control systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

F-24.04.01 select and use tools and equipment such as multimeters, clamp-on ammeters, hand tools, protocol communicators, calibrators and network analyzers

F-24.04.02 select and verify replacement component according to OEM specifications and engineered drawings

F-24.04.03 replace faulty wiring, and re-seat connectors and plugs in the control panel according to local regulations and site specifications

F-24.04.04 replace communication components and connectors according to engineered drawings

F-24.04.05 apply Force to output device from PLC or DCS to verify operation and remove Force out upon completion

F-24.04.06 put the loop in Manual mode to prevent process upset, and bypass alarms and shutdowns while doing the replacement, and put back to Automatic mode upon completion

F-24.04.07	isolate power and process prior to replacement
F-24.04.08	replace faulty component according to OEM specifications and engineered drawings
F-24.04.09	program and configure replaced component by setting protocol according to OEM specifications and engineered drawings
F-24.04.10	perform I/O (on/off) test after repair or replacement
F-24.04.11	perform analog I/O test after repair or replacement
F-24.04.12	upload and execute programs

Sub-task

F-24.05 Optimizes programmable logic controller (PLC).

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

F-24.05.01	ensure the version of the OEM manual matches the version of the OEM software
F-24.05.02	review and modify existing program and system parameters to match the changes of the process, and to ensure efficiency of program
F-24.05.03	ensure sequential programming logic to minimize scan time and add comments to record the changes
F-24.05.04	run program in test mode, and upload and execute programs required to update the system
F-24.05.05	tune control loops to optimize process
F-24.05.06	create back-up for every change made

BLOCK G

BUILDING AND ENVIRONMENTAL CONTROL SYSTEMS

Trends	More stringent regulations are causing a trend towards energy conservation and a rise in the use of environmentally friendly systems such as scrubbers and precipitators. There is an increasing need for skilled labour to install and maintain these systems.
Related Components (including, but not limited to)	Analyzers, skimmers, scrubbers, monitors, transducers, high voltage regulators and transformers, transmitters, photocells, motors, sensors, actuators, wiring and cabling, computers, printers, elements, compressors, solenoids, relays, contactors, thermostats, humidistats, thermocouples, RTDs, switches (pressure, level, temperature, flow), fuses, breakers, overload relays, PLCs, UPSs, transformer-rectifier sets.
Tools and Equipment	See Appendix A.

Task 25

Maintains electrical components of heating and cooling systems.

Context Industrial electricians work on electrical components of heating and cooling systems in order to optimize the operation and to ensure the reliability of the system. Industrial electricians must be able to install, service and repair these systems.

Required Knowledge

K 1	codes and regulations related to the electrical components of heating and cooling systems
K 2	types of heating systems such as heat pumps, boilers and resistive types
K 3	types of cooling systems such as heat pumps, chillers and exchangers
K 4	operation of heating and cooling systems
K 5	building applications such as refinery labs, hospitals, food processing plants and commercial buildings
K 6	air flow balancing
K 7	building construction such as brick, wood and corrugated panel
K 8	system sizing

K 9	confined space entry and egress regulations
K 10	types, ratings and operation of electrical components
K 11	faults such as failed zone actuators and damaged elements
K 12	events that lead to system failure
K 13	physical properties and hazards of refrigerants
K 14	history of equipment performance
K 15	repair, replacement, inspection, calibration, adjustment and maintenance procedures and techniques
K 16	compatibility of replacement components
K 17	types of lubricants

Sub-task

G-25.01 Installs electrical components of heating and cooling systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

G-25.01.01	select and use tools and equipment such as compression tools, wire strippers and pliers
G-25.01.02	ensure proper egress around heating and cooling system according to code requirements
G-25.01.03	assemble components to building management controllers according to OEM specifications
G-25.01.04	shim and level the cabinets
G-25.01.05	terminate cable according to code requirements
G-25.01.06	follow installation procedures according to OEM specifications and code requirements
G-25.01.07	perform adjustments such as setting high and low limits, fan speeds and temperature
G-25.01.08	verify system operation

Sub-task

G-25.02 Services electrical components of heating and cooling systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

G-25.02.01	select and use diagnostic tools and equipment such as hand tools, pressure simulators and multimeters
G-25.02.02	identify hazards when conducting inspections such as live voltages, dangerous gases, and restricted access and egress
G-25.02.03	de-energize system from power source
G-25.02.04	test system for zero potential using multimeter
G-25.02.05	perform and interpret diagnostic tests for conditions such as air quality and humidity levels
G-25.02.06	select tools and equipment such as pliers, screwdrivers and torque wrenches
G-25.02.07	disassemble/reassemble components according to OEM specifications
G-25.02.08	visually inspect components for deterioration such as corrosion, loose torque and discolouration using methods such as thermography for hot spots
G-25.02.09	identify abnormal heat, sounds and odours
G-25.02.10	identify components that require repair or replacement
G-25.02.11	clean and lubricate components
G-25.02.12	perform adjustments such as setting high and low limits, fan speeds and temperature
G-25.02.13	verify system operation

Sub-task

G-25.03 Troubleshoots electrical components of heating and cooling systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

G-25.03.01	identify hazards when conducting inspections such as live voltages, dangerous gases, and restricted access and egress
G-25.03.02	select and use diagnostic tools and equipment such as multimeters, clamp-on ammeters and megohmmeters
G-25.03.03	visually inspect components for deterioration such as corrosion, loose torque and discolouration
G-25.03.04	perform and interpret diagnostic tests for conditions such as air quality and humidity levels
G-25.03.05	de-energize system from power source
G-25.03.06	isolate faults by de-energizing source of energy
G-25.03.07	test system for zero potential using multimeter
G-25.03.08	identify components that require repair or replacement
G-25.03.09	perform adjustments such as setting high and low limits, fan speeds and temperature

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Sub-task

G-25.04 Repairs electrical components of heating and cooling systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

G-25.04.01	identify hazards when conducting repairs such as live voltages, dangerous gases, and restricted access and egress
G-25.04.02	select and use tools and equipment such as screwdrivers, wrenches and pliers
G-25.04.03	determine whether components require repair or replacement
G-25.04.04	select replacement components such as relays, contactors and fuses according to OEM specifications and code requirements
G-25.04.05	de-energize system from power source

G-25.04.06	test system for zero potential using multimeter
G-25.04.07	disassemble/reassemble components according to OEM specifications
G-25.04.08	replace, adjust and modify components such as relays, contactors and fuses
G-25.04.09	clean components before terminating to ensure good contact and continuity
G-25.04.10	verify operation of components

Task 26 Maintains building automation systems.

Context Building automation systems include energy, HVAC and security systems. Industrial electricians program, perform software updates and back up programs. They must be able to install, service and repair these systems in order to ensure their efficient operation and reduce unscheduled disruptions.

Required Knowledge

K 1	codes and regulations related to building automation systems
K 2	components, operation and types of building automation systems such as energy and security
K 3	procedures and techniques for servicing building automation systems
K 4	types, ratings and operation of electrical components such as temperature sensors and actuators
K 5	calibration devices such as air supply and current source potentiometers
K 6	history of equipment performance
K 7	calibration, repair, replacement, programming, adjustment and inspection procedures and techniques
K 8	building automation systems and software
K 9	faults such as temperature imbalance and unresponsive system
K 10	effects of faults on the system
K 11	events that lead to system failure
K 12	types of buildings using automated systems such as office buildings, manufacturing plants and hospitals
K 13	cabling and shielding

Sub-task

G-26.01 Installs building automation systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

G-26.01.01	select and use tools and equipment such as compression tools, wire strippers and pliers
G-26.01.02	ensure proper egress around building automation system according to code requirements
G-26.01.03	assemble components to building management controllers according to OEM specifications
G-26.01.04	shim and level the cabinets
G-26.01.05	terminate cable according to code requirements
G-26.01.06	follow installation procedures according to OEM specifications and code requirements
G-26.01.07	perform adjustments such as setting high and low limits, fan speeds and temperature
G-26.01.08	verify system operation

Sub-task

G-26.02 Services building automation systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

G-26.02.01	interpret building automation system software information
G-26.02.02	select and use diagnostic tools and equipment such as ammeters, computers and multimeters
G-26.02.03	identify hazards when conducting inspections such as live voltages, dangerous gases, and restricted access and egress
G-26.02.04	de-energize system from power source
G-26.02.05	test system for zero potential using multimeter
G-26.02.06	perform and interpret diagnostic tests

G-26.02.07 select and use tools and equipment such as pliers and screwdrivers

G-26.02.08 disassemble/reassemble components according to OEM specifications

G-26.02.09 perform sensory inspection of components for conditions such as corrosion, discolouration, abnormal heat, sounds and odours

G-26.02.10 identify components that require repair or replacement

G-26.02.11 clean and lubricate components

G-26.02.12 perform adjustments on components such as sensors, actuators and switches

G-26.02.13 verify system operation

Sub-task

G-26.03 Troubleshoots building automation systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

G-26.03.01 identify hazards when conducting inspections such as live voltages, dangerous gases, and restricted access and egress

G-26.03.02 select and use diagnostic tools and equipment such as multimeters, diagnostic equipment and clamp-on ammeters

G-26.03.03 perform sensory inspection of components for conditions such as corrosion, discolouration, abnormal heat, sounds and odours

G-26.03.04 perform and interpret diagnostic tests

G-26.03.05 de-energize system from power source

G-26.03.06 isolate faults by de-energizing source of energy

G-26.03.07 test system for zero potential using multimeter

G-26.03.08 identify components that require repair or replacement

Sub-task

G-26.04 Repairs building automation systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

G-26.04.01	identify hazards when conducting repairs such as live voltages, dangerous gases, and restricted access and egress
G-26.04.02	select and use tools and equipment such as screwdrivers, wrenches and pliers
G-26.04.03	determine whether components require repair or replacement
G-26.04.04	select replacement components such as relays, sensors and fuses according to OEM specifications and code requirements
G-26.04.05	de-energize system from power source
G-26.04.06	test system for zero potential using multimeter
G-26.04.07	disassemble/reassemble components according to OEM specifications
G-26.04.08	replace, adjust and modify components such as relays, sensors and fuses
G-26.04.09	clean components before terminating to ensure good contact and continuity
G-26.04.10	verify operation of components

Task 27 Maintains environmental control systems.

Context Environmental control systems regulate and monitor emissions. These emissions are typically from industrial processes but may also come from residential, institutional and commercial buildings. Industrial electricians must be able to install, service and repair these systems in order to ensure their efficient operation and reduce unscheduled disruptions.

Required Knowledge

K 1	codes and regulations regarding environmental control systems
K 2	types and operation of environmental control systems such as waste management, noise reduction, precipitator, water treatment, dust suppression, scrubber and stack emissions
K 3	characteristics and specifications of components such as samplers, particulate analyzers and skimmers

K 4	inspection, installation, operation, calibration and preventative maintenance procedures and schedules of environmental control systems
K 5	hazards such as chemicals, gases, ultraviolet light and high voltage
K 6	impact of environmental control system shutdown
K 7	causes of faults
K 8	events that lead to system failure
K 9	diagnostic equipment such as leak detectors, meters and stack monitors
K 10	history of equipment performance
K 11	response and containment of environmental discharge
K 12	environmental regulations

Sub-task

G-27.01 Installs environmental control systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	no	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

G-27.01.01	select and use tools and equipment such as compression tools, wire strippers and pliers
G-27.01.02	ensure proper egress around environmental control system according to code requirements
G-27.01.03	assemble components of environmental control systems according to OEM specifications
G-27.01.04	shim and level the cabinets
G-27.01.05	terminate cable according to code requirements
G-27.01.06	follow installation procedures according to OEM specifications and code requirements
G-27.01.07	store, contain, handle and dispose of hazardous materials according to regulations
G-27.01.08	verify system operation

Sub-task

G-27.02 **Services environmental control systems.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	no	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

G-27.02.01	select and use diagnostic tools and equipment such as leak detectors, megohmmeters and multimeters
G-27.02.02	identify hazards when conducting inspections such as chemicals, ultraviolet light, residue and high voltage
G-27.02.03	de-energize system from power source
G-27.02.04	test system for zero potential using multimeter
G-27.02.05	perform and interpret diagnostic tests such as leak and fault tests
G-27.02.06	select tools and equipment such as pliers, screwdrivers and torque wrenches
G-27.02.07	disassemble/reassemble components according to OEM specifications
G-27.02.08	perform sensory inspection of components for conditions such as corrosion, loose torque, discolouration, and abnormal heat, sounds and odours
G-27.02.09	identify components that require repair or replacement
G-27.02.10	clean and lubricate components
G-27.02.11	perform adjustments such as calibration, and high and low limits
G-27.02.12	store, contain, handle and dispose of hazardous materials according to regulations
G-27.02.13	verify system operation

Sub-task

G-27.03 **Troubleshoots environmental control systems.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	no	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

G-27.03.01	identify hazards when conducting inspections such chemicals, ultraviolet light, residue and high voltage
G-27.03.02	select and use diagnostic tools and equipment such as leak detectors, megohmmeters and multimeters

G-27.03.03 disassemble/reassemble components according to OEM specifications

G-27.03.04 perform sensory inspection of components for conditions such as corrosion, loose torque, discolouration, and abnormal heat, sounds and odours

G-27.03.05 perform and interpret diagnostic tests for conditions such as air quality and humidity levels

G-27.03.06 de-energize system from power source

G-27.03.07 isolate faults by de-energizing source of energy

G-27.03.08 test system for zero potential using multimeter

G-27.03.09 identify components that require repair or replacement

G-27.03.10 store, contain, handle and dispose of hazardous materials according to regulations

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Sub-task

G-27.04 **Repairs environmental control systems.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	no	yes	yes	yes	yes	ND	ND	yes	ND	NV	ND

Key Competencies

G-27.04.01 identify hazards when conducting repairs such as chemicals, ultraviolet light, residue and high voltage

G-27.04.02 select and use tools and equipment such as screwdrivers, wrenches and pliers

G-27.04.03 disassemble/reassemble components according to OEM specifications

G-27.04.04 determine whether components require repair or replacement

G-27.04.05 select replacement components such as relays, contactors and fuses according to OEM specifications and code requirements

G-27.04.06 de-energize system from power source

G-27.04.07 test system for zero potential using multimeter

G-27.04.08 replace, adjust and modify components such as pressure switches, samplers and particulate analyzers

G-27.04.09 clean components before terminating to ensure good contact and continuity

G-27.04.10 store, contain, handle and dispose of hazardous materials according to regulations

G-27.04.11 verify operation of components

APPENDICES

APPENDIX A

TOOLS AND EQUIPMENT

Hand Tools

adjustable wrenches
cable splice/stripper tool
cable tie gun
calculator
chisels
coaxial stripper and crimper
crimping pliers
drill bits
files
fish tape
flashlight
fuse puller
grounding set
hack saw
hammers
hex keys (metric/imperial or Society of Automotive Engineers [SAE])
hole saw
jumpers
knives
knock-out cutters
linesman pliers
needle nose pliers
nut drivers (metric/imperial or SAE)
picks
pipe benders
pipe threader
pullers
punch
scraper
screwdrivers
screw starter
scribe
semi-conductor extactor
side cutters
slide lock pliers
socket set (metric/imperial or SAE)
spline keys
static discharge wristbands and anti-static mats
taps (metric/imperial or SAE) and dies
tape measures
telescopic magnet
telescopic mirror
torch (butane, propane, oxy-acetylene)
trouble light
voice data crimp tools
voice data punch down tool
wire strippers
wrenches

Portable Power Tools

circular saw
cut-off saw
drill
grinder
hammer drill
heat gun
hole saw
hydraulic crimper
hydraulic knock-out punch
impact gun
jig saw
magnetic base drill press
power pipe bender
pipe threading machine
PVC bender
reciprocating saw
soldering equipment
step drill
wire puller

Powder-Actuated Tools

exothermic welding equipment (CAD welding)
powder-actuated fastening tool

Stationary Power Tools

band saw
bearing heater
belt sander
bench grinder
buffer
chop saw
drill press
grinder
hydraulic power unit
hydraulic press
parts washer
sand blaster
threading machine
under cutting machine

Electrical Test and Diagnostic Equipment

chart recorder
circuit tracer
clamp-on ammeter
conductivity tester
contact resistance meter
frequency meter
Geiger counter
ground fault finder
hi-pot tester
instrumentation loop calibrator
insulation resistance tester (megohmmeter/megger)
laptop computer and software
lumin meter (testing light)
multimeter
network analysers
non-contact voltage tester
optical power meter and light source
optical time domain reflectometer (OTDR)
oscilloscope
personal digital assistant (PDA)
phase sequence tester
potential tester
pressure calibration pump
signal generator
sound meter
temperature gun
thermal graphic camera
thermal graphic equipment
time domain reflectometer (TDR)
timer
voltage tester
Wheatstone bridge

Mechanical Measuring Equipment

alignment tools
dial indicators
distance measuring wheel
feeler gauges
hydrometer
Micrometers
pressure gauges
protractor
tachometer
torque wrench
vernier calipers
vibration sensor (accelerometer, velocity, proximity)

Rigging, Tugging, Hoisting, Lifting Material

articulated boom lift
beam clamps
block and tackle
cable puller (hand or electric powered)
cable pulling grips (wire mesh grips)
chain fall/come-along
hoists
lifting eyes
platform lift
pulley
ropes
scissor lift
shackles
slings
strain relief
tow motor/fork lift

Scaffolding and Access Equipment

aerial man lift
extension ladder
man baskets
portable stairs
scaffolds
step ladder

Personal Protective Equipment and Safety Equipment

arc flash PPE
ear protectors
face shield
fall arrest equipment
fall restraint equipment
fire retardant clothing
gas detectors
grounding stick
hard hat
harness
high visibility vests
high voltage gloves
high voltage test equipment
hot gloves
hot pad
hot stick
knee pads
protective apron
protective gloves/gauntlets
respirator
safety footwear
safety glasses/goggles
Self Contained Breathing Apparatus (SCBA)

APPENDIX B

GLOSSARY

arc flash	electrical explosion that occurs on live equipment resulting from a low impedance connection to ground or another voltage phase in an electrical system. The intensity of the blast is dependent on the energy source and the size of the conductors
bonding	low impedance path obtained by permanently joining all non-current-carrying metal parts to assure electrical continuity and having the capacity to conduct safely any current likely to be imposed on it
bump test	a functional test used on rotating equipment that initiates a start to determine a) if the correct equipment will turn, b) the direction of rotation or c) if the correct equipment is de-energized
cable	insulated or sheathed, wire or fibre, carrying current or light, it can be comprised of one or more conductors
cathodic protection	protection technique to control the corrosion of a metal surface by making that surface the cathode of an electrochemical cell
commissionning	initial startup of new equipment systematically to OEM specifications
Force	manual virtual bypass that is placed in control system program logic, that can be On or Off, it can be used for troubleshooting, temporary repairs, servicing and diagnostics. A Force will flag up in the system as long as it is in effect
grounding	permanent and continuous conductive path to the earth with sufficient ampacity to carry any fault current liable to be imposed on it, and of a sufficiently low impedance to limit the voltage rise above ground and to facilitate the operation of the protective devices in the circuit
high voltage	any voltage exceeding 750 volts, as per CEC
low voltage	any voltage from 31 to 750 volts, as per CEC
multimedia system	an electronically delivered combination of media including video, still images, audio, text in such a way that can be accessed interactively
raceway	any channel designed for holding wires, cables, or busbars, and, unless otherwise qualified by rules of the CEC, the term includes conduit (rigid, flexible, metal, non-metallic) electrical, metallic and nonmetallic tubing, underfloor raceways, cellular floors, surface raceways, wireways, cable trays, busways, and auxiliary gutters

APPENDIX C

ACRONYMS

AC	alternating current
AECB	Atomic Energy Control Board
CAD	computer assisted design
CAM	computer-aided manufacturing
CAT-5	category 5 cable
CEC	Canadian Electrical Code
CFL	compact fluorescent lamp
CMMS	computerized maintenance management system
CPR	cardiopulmonary resuscitation
CPU	central processing unit
CSA	Canadian Standards Association
dB	decibel
DC	direct current
DCS	distributed control system
EMI	electromagnetic interference
EMT	electrical metallic tubing
EOL	end of line
GFCI	ground-fault circuit interrupter
H_2S	hydrogen sulfide
HID	high intensity discharge
HMI	human machine interface
HVAC	heating, ventilation, and air conditioning
I/O	input/output

I/P	current to pressure
IC	integrated circuit
IP	internetworking protocol
kVA	kilovolt-ampere
LED	light emitting diode
MCC	motor control centre
MSDS	material safety data sheets
OEM	original equipment manufacturer
OH&S	Occupational Health and Safety
PPE	personal protective equipment
PLC	programmable logic controller
PVC	polyvinyl chloride
RTD	resistance temperature detector
SCR	silicon-controlled rectifier
SG	specific gravity
SO_2	sulfur dioxide
T/P	temperature to pressure
TDG	transportation of dangerous goods
ULC	Underwriters' Laboratories of Canada
UPS	uninterruptible power supply
VFD	variable-frequency drive
WHMIS	Workplace Hazardous Materials Information System

APPENDIX D

BLOCK AND TASK WEIGHTING

BLOCK A COMMON OCCUPATIONAL SKILLS

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	10	14	10	10	15	20	14	ND	ND	10	ND	NV	ND	13%

Task 1 Performs safety-related functions.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	50	25	20	25	20	50	25	ND	ND	30	ND	NV	ND	31%

Task 2 Uses and maintains tools and equipment.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	15	25	30	25	20	15	25	ND	ND	15	ND	NV	ND	21%

Task 3 Organizes work.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	35	25	20	25	30	10	25	ND	ND	40	ND	NV	ND	26%

Task 4 Performs routine trade activities.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	0	25	30	25	30	25	25	ND	ND	15	ND	NV	ND	22%

BLOCK B POWER DISTRIBUTION AND GENERATING SYSTEMS

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	25	21	20	20	20	14	14	ND	ND	22	ND	NV	ND	19%

Task 5 Maintains high voltage power distribution systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	8	0	10	0	10	5	20	ND	ND	16	ND	NV	ND	9%

Task 6 Maintains low voltage power distribution systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	30	30	20	20	25	25	16	ND	ND	25	ND	NV	ND	24%

Task 7 Maintains alternating current (AC) systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	30	30	30	30	25	30	16	ND	ND	25	ND	NV	ND	27%

Task 8 Maintains direct current (DC) systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	6	20	10	30	15	15	16	ND	ND	14	ND	NV	ND	16%

Task 9 Maintains grounding and bonding systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	20	20	15	20	15	15	16	ND	ND	12	ND	NV	ND	16%

Task 10 Maintains power generating systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	6	0	15	0	10	10	16	ND	ND	8	ND	NV	ND	8%

BLOCK C ELECTRICAL EQUIPMENT

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	25	23	30	20	20	25	14	ND	ND	22	ND	NV	ND	22%

Task 11 Maintains equipment, wiring, cabling and terminations.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	20	10	10	10	20	15	20	ND	ND	25	ND	NV	ND	16%

Task 12 Maintains lighting systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	8	10	15	10	20	10	16	ND	ND	10	ND	NV	ND	12%

Task 13 Maintains protection devices.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	20	20	10	20	10	15	16	ND	ND	15	ND	NV	ND	16%

Task 14 Maintains rotating equipment and associated controls.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	20	20	30	20	20	25	16	ND	ND	20	ND	NV	ND	22%

Task 15 Maintains drives and associated controls.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	12	20	20	20	15	25	16	ND	ND	15	ND	NV	ND	18%

Task 16 Maintains non-rotating equipment and associated controls.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	20	20	15	20	15	10	16	ND	ND	15	ND	NV	ND	16%

BLOCK D EMERGENCY AND STANDBY SYSTEMS

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	5	10	10	10	10	5	14	ND	ND	7	ND	NV	ND	9%

Task 17 Maintains uninterruptible power supply (UPS) systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	50	60	80	50	45	40	50	ND	ND	50	ND	NV	ND	53%

Task 18 Maintains standby power generating systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	50	40	20	50	55	60	50	ND	ND	50	ND	NV	ND	47%

BLOCK E COMMUNICATION SYSTEMS

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	10	10	5	10	5	6	14	ND	ND	10	ND	NV	ND	9%

Task 19 Maintains alarm systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	40	30	25	100	25	40	0	ND	ND	50	ND	NV	ND	44%

Task 20 Maintains paging systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	10	25	25	0	25	25	50	ND	ND	10	ND	NV	ND	24%

Task 21 Maintains multimedia systems. (NOT COMMON CORE)

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	10	0	0	0	25	5	50	ND	ND	10	ND	NV	NV	NCC*

Task 22 Maintains network systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	40	45	50	0	25	30	0	ND	ND	30	ND	NV	ND	32%

BLOCK F PROCESS CONTROL SYSTEMS

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	20	13	20	20	15	24	14	ND	ND	22	ND	NV	ND	19%

Task 23 Maintains input/output (I/O) field devices.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	50	55	60	70	50	50	50	ND	ND	40	ND	NV	ND	53%

Task 24 Maintains control systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	50	45	40	30	50	50	50	ND	ND	60	ND	NV	ND	47%

BLOCK G BUILDING AND ENVIRONMENTAL CONTROL SYSTEMS

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	5	9	5	10	15	6	16	ND	ND	7	ND	NV	ND	9%

Task 25 Maintains electrical components of heating and cooling systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	40	40	70	0	30	45	33	ND	ND	40	ND	NV	ND	37%

Task 26 Maintains building automation systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	20	30	30	0	30	25	34	ND	ND	30	ND	NV	ND	25%

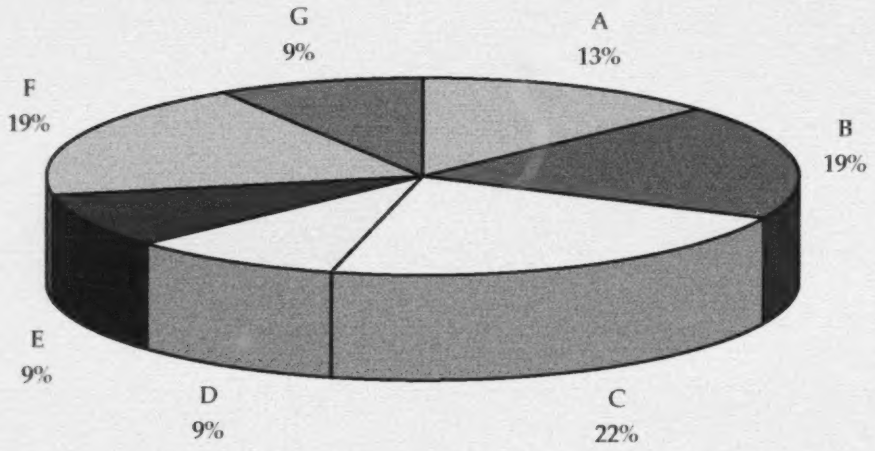
Task 27 Maintains environmental control systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	40	30	0	100	40	30	33	ND	ND	30	ND	NV	ND	38%

*NCC = Not common core

APPENDIX E

PIE CHART*



TITLES OF BLOCKS

BLOCK A	Common Occupational Skills
BLOCK B	Power Distribution and Generating Systems
BLOCK C	Electrical Equipment
BLOCK D	Emergency and Standby Systems
BLOCK E	Communication Systems
BLOCK F	Process Control Systems
BLOCK G	Building and Environmental Control Systems

*Average percentage of the total number of questions on an interprovincial examination, assigned to assess each block of the analysis, as derived from the collective input from workers within the occupation from all areas of Canada. Interprovincial examinations typically have from 100 to 150 multiple-choice questions.

APPENDIX F

TASK PROFILE CHART — Industrial Electrician

BLOCKS	TASKS	SUB-TASKS				
A - COMMON OCCUPATIONAL SKILLS	1. Performs safety-related functions.	1.01 Maintains safe work environment.	1.02 Uses personal protective equipment (PPE) and safety equipment.	1.03 Performs lock-out and tagging procedures.		
	2. Uses and maintains tools and equipment.	2.01 Maintains tools and equipment.	2.02 Uses access equipment.	2.03 Uses rigging, tugging, hoisting and lifting equipment.		
	3. Organizes work.	3.01 Interprets codes and regulations.	3.02 Uses plans, schematics, drawings and specifications.	3.03 Selects materials and supplies.	3.04 Plans project tasks and procedures.	3.05 Prepares work site.
		3.06 Documents maintenance work.				
	4. Performs routine trade activities.	4.01 Installs fasteners, fittings and connectors.	4.02 Conducts operational tests.			
B - POWER DISTRIBUTION AND GENERATING SYSTEMS	5. Maintains high voltage power distribution systems.	5.01 Installs high voltage power distribution systems. (NOT COMMON CORE)	5.02 Services high voltage power distribution systems.	5.03 Troubleshoots high voltage power distribution systems.	5.04 Repairs high voltage power distribution systems.	
	6. Maintains low voltage power distribution systems.	6.01 Installs low voltage power distribution systems.	6.02 Services low voltage power distribution systems.	6.03 Troubleshoots low voltage power distribution systems.	6.04 Repairs low voltage power distribution systems.	

BLOCKS	TASKS	SUB-TASKS			
C - ELECTRICAL EQUIPMENT	7. Maintains alternating current (AC) systems.	7.01 Installs alternating current (AC) systems.	7.02 Services alternating current (AC) systems.	7.03 Troubleshoots alternating current (AC) systems.	7.04 Repairs alternating current (AC) systems.
	8. Maintains direct current (DC) systems.	8.01 Installs direct current (DC) systems.	8.02 Services direct current (DC) systems.	8.03 Troubleshoots direct current (DC) systems.	8.04 Repairs direct current (DC) systems.
	9. Maintains grounding and bonding systems.	9.01 Installs grounding and bonding systems.	9.02 Services grounding and bonding systems.	9.03 Troubleshoots grounding and bonding systems.	9.04 Repairs grounding and bonding systems.
	10. Maintains power generating systems.	10.01 Installs power generating systems. (NOT COMMON CORE)	10.02 Services power generating systems.	10.03 Troubleshoots power generating systems.	10.04 Repairs power generating systems.
	11. Maintains equipment, wiring, cabling and terminations.	11.01 Installs electrical wiring, cabling and terminations.	11.02 Installs raceways, cable trays, busways and associated components.	11.03 Repairs electrical wiring, cabling and terminations.	11.04 Maintains seismic restraint systems. (NOT COMMON CORE)
	12. Maintains lighting systems.	12.01 Installs lighting systems.	12.02 Services lighting systems.	12.03 Troubleshoots lighting systems.	12.04 Repairs lighting systems.
	13. Maintains protection devices.	13.01 Installs protection devices.	13.02 Services protection devices.	13.03 Troubleshoots protection devices.	13.04 Repairs protection devices.
	14. Maintains rotating equipment and associated controls.	14.01 Installs rotating equipment and associated controls.	14.02 Services rotating equipment and associated controls.	14.03 Troubleshoots rotating equipment and associated controls.	14.04 Repairs rotating equipment and associated controls.

BLOCKS	TASKS	SUB-TASKS			
	15. Maintains drives and associated controls.	15.01 Installs drives and associated controls.	15.02 Services drives and associated controls.	15.03 Troubleshoots drives and associated controls.	15.04 Repairs drives and associated controls.
	16. Maintains non-rotating equipment and associated controls.	16.01 Installs non-rotating equipment and associated controls.	16.02 Services non-rotating equipment and associated controls.	16.03 Troubleshoots non-rotating equipment and associated controls.	16.04 Repairs non-rotating equipment and associated controls.
D - EMERGENCY AND STANDBY SYSTEMS	17. Maintains uninterruptible power supply (UPS) systems.	17.01 Installs uninterruptible power supply (UPS) systems.	17.02 Services uninterruptible power supply (UPS) systems.	17.03 Troubleshoots uninterruptible power supply (UPS) systems.	17.04 Repairs uninterruptible power supply (UPS) systems.
	18. Maintains standby power generating systems.	18.01 Installs standby power generating systems.	18.02 Services standby power generating systems.	18.03 Troubleshoots standby power generating systems.	18.04 Repairs standby power generating systems.
E - COMMUNICATION SYSTEMS	19. Maintains alarm systems.	19.01 Installs alarm systems.	19.02 Services alarm systems.	19.03 Troubleshoots alarm systems.	19.04 Repairs alarm systems.
	20. Maintains paging systems.	20.01 Installs paging systems.	20.02 Services paging systems.	20.03 Troubleshoots paging systems.	20.04 Repairs paging systems.
	21. Maintains multimedia systems. (NOT COMMON CORE)	21.01 Installs multimedia systems. (NOT COMMON CORE)	21.02 Services multimedia systems. (NOT COMMON CORE)	21.03 Troubleshoots multimedia systems. (NOT COMMON CORE)	21.04 Repairs multimedia systems. (NOT COMMON CORE)
	22. Maintains network systems.	22.01 Installs network systems.	22.02 Services network systems.	22.03 Troubleshoots network systems.	22.04 Repairs network systems.

BLOCKS	TASKS	SUB-TASKS				
F - PROCESS CONTROL SYSTEMS	23. Maintains input/output (I/O) field devices.	23.01 Installs input/output (I/O) field devices.	23.02 Services input/output (I/O) field devices.	23.03 Troubleshoots input/output (I/O) field devices.	23.04 Repairs input/output (I/O) field devices.	
	24. Maintains control systems.	24.01 Installs control systems.	24.02 Services control systems.	24.03 Troubleshoots control systems.	24.04 Repairs control systems.	24.05 Optimizes programmable logic controller (PLC).
G - BUILDING AND ENVIRONMENTAL CONTROL SYSTEMS	25. Maintains electrical components of heating and cooling systems.	25.01 Installs electrical components of heating and cooling systems.	25.02 Services electrical components of heating and cooling systems.	25.03 Troubleshoots electrical components of heating and cooling systems.	25.04 Repairs electrical components of heating and cooling systems.	
	26. Maintains building automation systems.	26.01 Installs building automation systems.	26.02 Services building automation systems.	26.03 Troubleshoots building automation systems.	26.04 Repairs building automation systems.	
	27. Maintains environmental control systems.	27.01 Installs environmental control systems.	27.02 Services environmental control systems.	27.03 Troubleshoots environmental control systems.	27.04 Repairs environmental control systems.	